IV. SPECIES

A. Introduction

This section describes the natural history, distribution, and abundance of the species identified for this document (Table 2) and analyzes the effects to each species resulting from current lower Colorado River operation and maintenance activities. The species are grouped according to their principal habitat requirements (terrestrial, marsh, or aquatic), and a summary of the effect analyses is provided at the end of this section in Table 15. This section also includes a discussion of the designated critical habitat for the razorback sucker and bonytail along the lower Colorado River.

B. Terrestrial

1. Endangered

a. Peregrine Falcon (*Falco peregrinus*)

Description and Life Requisites

Peregrine habitat often consists of cliffs adjacent to productive foraging habitat associated with wetlands, rivers, and lakes. River canyons are highly attractive to breeding peregrines due to numerous potential nesting cliffs, relative abundant prey and ideal hunting conditions (Skaggs et al. 1988). Although eyries are typically located on cliffs overlooking preferred foraging habitat, the exact location can change from year to year, and in any year can be up to several miles from the previous location (Call 1978).

The peregrine's diet consists mainly of birds, including waterfowl, shorebirds, songbirds, and gallinaceous birds (Herron et al. 1985). Bats have also been observed as prey items in the Black Canyon area below Hoover Dam (Glinski pers. comm. 1995). Studies conducted by AGFD (1991) suggest that the area within a half mile of the eyrie is the most extensively used area for foraging.

Previous studies have suggested that human activities within breeding and nesting territories could affect raptors in general by changing home range movements and nest abandonment (Postovit and Postovit 1987; Porter et al. 1973). On the other hand, peregrine falcons have nested in situations where there was a high level of disturbance such as on buildings in urban settings (The Peregrine Fund 1983) and where there were disturbances from low flying military jets and subsequent sonic booms (Ellis 1980). A recent study has indicated that nesting peregrine falcons were tolerant of construction blasting at least 125 meters from their nests (Holthuijzen et al. 1990). However, regardless of distance, peak noise levels should not exceed 140 dB at any eyrie site and no more than 3 blasts should occur on any given day, or 90 total blasts during the nesting season (Werner pers. comm. 1996).

Distribution and Abundance

Historically, peregrine falcons were relatively common in the Southwest, but during the 1950s the population declined. Only three active nests were known in Arizona in 1975 (Ellis 1976). Few pairs of peregrine falcons have bred historically along the lower Colorado River (Ellis 1985). Recently, there has been a general increase in reproductive success (Skaggs et al. 1988) generally attributed to the ban of DDT. In 1990, over 179 nesting sites were found in Arizona (Glinski, pers. comm.).

In 1990, AGFD performed surveys for breeding peregrines in the northern reaches of Black Canyon (within 15 miles of Hoover Dam) to assess potential impacts from a proposed bridge crossing. During these surveys, five occupied peregrine breeding areas were found. Observed density of peregrine falcons in the Black Canyon during this study effort was similar to that found in the Grand Canyon where a peregrine falcon breeding area exists about every 3 miles along the river in suitable precipitous terrain (AGFD 1991). Current studies indicate that peregrines may occupy breeding territories in the study area in every month of the year except December and January. Nesting peregrines have not been observed downstream of Lake Mohave, but potential nesting habitat exists along the lower river in Topock

Gorge and adjacent to the Bill Williams delta (Glinski pers. comm. 1995).

Effects Analysis

Direct Effects - Direct effects to peregrine falcons from river operation or maintenance activities along the lower Colorado River are not expected to occur. No bankline stabilization or dredging activities are anticipated in areas along the lower river where peregrine falcons are known to occur or in areas where there may be potential nesting habitat. Release of water from existing facilities will not have an effect to peregrine falcons along the lower Colorado River.

Peregrine falcons are not known to occur in any of the future proposed quarry site locations. However, section 7 consultation for these sites is presently underway, and a separate analysis of effects for these sites will be determined during this effort.

Indirect Effects - Other than potential quarry activities, no future interrelated and/or interdependent activities associated with river operations and/or maintenance activities along the lower Colorado River are anticipated which may have an effect on peregrine falcons. As stated above, peregrine falcons have not been observed in any of the proposed quarry site locations, however, all effect determinations concerning these activities will be made through a separate (presently ongoing) section 7 consultation effort.

Cumulative Effects - Future non-Federal activities occurring within the action area and which may (extent unknown) effect peregrine falcons include river associated recreational use such as boating, skiing, jet skiing and pesticide use as might be associated with agri-business.

b. Southwestern Willow Flycatcher (*Empidonax traillii extimus*)

Description and Life Requisites

The southwestern willow flycatcher is one of ten species in the genus *Empidonax* found in North America. *Empidonax* flycatchers are renowned for their physical similarities and, thus, for the difficulty in identifying individuals in the field (Phillips et al. 1964; Peterson 1990; Tibbitts et al. 1994). *Empidonax traillii* is further divided taxonomically into four subspecies. In January 1992, FWS was petitioned to list the southwestern willow flycatcher (*E. t. extimus*) as an endangered species. In July 1993, it was proposed as an endangered species with critical habitat (58FR39495). On February 27, 1995, FWS listed the southwestern willow flycatcher as an endangered species (60FR10694). There are no recovery plans in place as of June 1996 and the designated critical habitat does not include the lower Colorado River (60FR10694).

The southwestern willow flycatcher is a small bird, approximately 5.75 inches in length, with a grayish-green back and wings, whitish throat, light grey-olive breast, and pale yellowish body. Two white wing bars are visible. The upper mandible is dark, the lower light. The most distinguishable taxonomic characteristic of the southwestern willow flycatcher is the absent or faintly visible eye ring. The southwestern willow flycatcher can be differentiated from other species by its distinctive "fitz-bew" song.

The southwestern willow flycatcher is a neotropical migrant. They winter in Mexico, Central America, and possibly in northern South America (Peterson 1990; Tibbitts et al. 1994). Southwestern willow flycatchers begin arriving in breeding territory in mid-May and may continue to be present until August. They build nests and lay eggs in late May or early June and fledge young in late June or early July (Tibbitts et al. 1994). Typically, the southwestern willow flycatcher raises one brood per year. Breeding territory for the southwestern willow flycatcher extends from extreme southern Utah and Nevada, through Arizona, New Mexico, southern California, and west Texas to extreme northern Baja California and Sonora, Mexico (Unitt 1987).

Southwestern willow flycatchers nest in riparian habitat characterized by a dense stand of intermediate sized shrubs or trees, such as willows (especially *Salix gooddingii*), *Baccharis*, or arrowweed (*Tessaria sericea*), usually with an overstory of scattered larger trees, such as cottonwoods (*Populus fremontii*). Most southwestern willow flycatcher nests are located in the fork of a shrub or tree from 4 to 25 feet above the ground (Unitt 1987; Tibbitts et al. 1994). Nesting habitat almost always contains or is adjacent to water or saturated soil (Phillips et al. 1964; Muiznieks et al.

1994). With the loss of preferred habitat throughout the Southwest, southwestern willow flycatchers have been observed utilizing saltcedar (*Tamarix* sp.) thickets for nesting (Brown and Johnson 1990; Martin Jakle USBR, pers. comm.).

The southwestern willow flycatcher is an insectivore. It forages within and above dense riparian vegetation taking insects on the wing and gleaning them from the foliage. It also forages along water edges, backwaters, and sandbars, adjacent to nest sites. Details on specific prey items are not currently known (Tibbitts et al. 1994).

Distribution and Abundance

Historically, the southwestern willow flycatcher was widely distributed and fairly common throughout its range, especially in southern California and Arizona (Unitt 1987; Schlorff 1990). Nest and egg collections by Herbert Brown suggest that the southwestern willow flycatcher was a common breeder along the lower Colorado River near Yuma in 1902 (Unitt 1987). Grinnell (1914) also believed that the southwestern willow flycatcher bred along the lower Colorado River due to the similarities in habitat between the lower Colorado River and other known breeding sites. He noted the abundance of southwestern willow flycatchers observed in the willow association and possible breeding behavior. However, the date of his expedition corresponds more to the migration season of the southwestern willow flycatcher with only a small overlap with the beginning of the breeding season.

Southwestern willow flycatcher populations have apparently declined. In 1993, FWS estimated that only 230 to 500 nesting pairs existed throughout its entire range (58FR39495). In recent years, the population was believed to be extirpated from the lower Colorado River (Hunter et al. 1987; Rosenberg et al. 1991). However, birds have been observed in several locations along the lower Colorado River during breeding season since 1993 (Sferra et al. 1995). Two fledgling southwestern willow flycatchers were observed on Havasu National Wildlife Refuge in 1995, strongly suggesting that successful nesting had occurred (Christy Smith, FWS, pers. comm.; Spencer et al. 1996). These fledgling birds were observed in a saltcedar-willow mix dominated by saltcedar.

Several factors have caused the decline in southwestern willow flycatcher populations. Extensive areas of suitable riparian habitat have been lost due to river regulation and channelization, agricultural and urban development, mining, road construction, and overgrazing (Phillips et al. 1964; Johnson and Haight 1984; Unitt 1987; Rosenberg et al. 1991; Tibbitts et al. 1994). As a result of habitat fragmentation cowbird (*Molothrus ater*) parasitism has increased(Unitt 1987; Brown 1988; Rosenberg et al. 1991; Sogge et al. 1993; Muiznieks et al. 1994). The invasion of the exotic saltcedar has also altered the riparian ecosystem in the Southwest. Saltcedar may not provide the thermal cover necessary for southwestern willow flycatchers to nest successfully in many areas, including the lower Colorado River Valley (Hunter et al. 1987; Hunter et al. 1988). However, southwestern willow flycatcher nesting has been documented in *Tamarisk* stands between 2,000 and 3,500 feet in elevation (Hunter et al. 1987; Brown 1988; Sogge et al. 1993; Muiznieks et al. 1994). Many of the observations of southwestern willow flycatcher since 1993, including the fledglings at Havasu National Wildlife Refuge, have occurred in habitat dominated by saltcedar (Christy Smith, FWS, pers. comm.; Spencer et al. 1996). This provides strong evidence that successful breeding is occurring in saltcedar on the lower Colorado River.

During the spring of 1996, Reclamation initiated a comprehensive study effort, under contract with the San Bernardino County Museum, San Bernardino County, California, to determine the distribution, abundance, life requisites, and habitat use of southwestern willow flycatchers along the lower Colorado River from Lake Mead to the SIB. Although the study effort is presently ongoing and data, to date, are preliminary, initial results indicate that the southwestern willow flycatcher does breed and nest along the lower Colorado River at a greater degree than originally thought. As of July 10, 1996, the effort has resulted in the observation of three active nests and several additional possible breeders (potentially 10 additional breeding pairs) during the 1996 breeding season. The three active nests were observed in the ephemeral willow habitat of the Colorado River delta within Lake Mead (See Figure 28). The study effort has also resulted in the observation of a pair of southwestern willow flycatchers carrying nesting material near Ehrenberg (Robert McKernan, San Bernardino County Museum, pers. comm.). Reclamation will keep FWS appraised of the results of the continuing effort.

Effect Analysis

It is anticipated that native riparian vegetation, especially the cottonwood-willow association historically utilized by the southwestern willow flycatcher, will decline slightly over the next 5 years. Although total acres of cottonwood-willow have fallen precipitously since 1976, the majority of loss has occurred in the young age classes. The percentage of cottonwood-willow stands categorized as CW V or CW VI ranged from 33 percent to 57 percent prior to the 1994 survey. The 1994 survey found only 12 percent of the cottonwood-willow stands present as CW V or CW VI (Table 12). These young stands are more susceptible to loss from desiccation, fire, or saltcedar competition. More mature stands may be lost to fire activity but these numbers are difficult to quantify. Reclamation's operations do inhibit regeneration of new cottonwood-willow stands by limiting flood events. However, two flood events have occurred in the last 15 years which have resulted in the establishment of new cottonwood-willow stands at points along the lower Colorado River. Saltcedar acreage should remain relatively steady over the next 5 years.

Direct Effects - Until the ongoing surveys conducted by the San Bernardino County Museum are completed, it is difficult to quantify direct affects on the southwestern willow flycatcher by Reclamation's ongoing operations and maintenance. Current data and observations indicate that there may be some use of the lower Colorado River by breeding southwestern willow flycatchers (Spencer et al. 1996; Robert McKernan, San Bernardino County Museum, pers. comm.). If breeding is ongoing, it may not be limited to historic breeding habitat but may also be occurring in saltcedar.

The total acreage occupied by riparian vegetation has changed little in the last 20 years (Anderson and Ohmart 1976; Younker and Anderson 1986; John Carlson and David Salas, USBR, pers. comm.). There has been a change in the amount and structure of native riparian habitat, however, especially the cottonwood-willow associations utilized historically by the southwestern willow flycatcher. The total acreage occupied by cottonwood-willow below Davis Dam has decreased

Table 12. Acreage comparison for cottonwood-willow and saltcedar communities/structures between 1976 and 1994 along the lower Colorado River from Davis Dam to the U.S./ Mexico boundary.

Community/structure type	1976a	1983b	1986c	1994d
Cottonwood-willow: I	383	0	0	68
II	94	161	225	151
III	464	586	502	1833
IV	4396	4527	1733	928
V	2417	1680	2867	152
VI	534	929	427	266
Total cottonwood-willow	**8288**	**7883**	**5754**	**3398**
Saltcedar: I	106	326	310	290
II	188	99	9	87
III	333	420	11	267
IV	25090	22249	22381	24092

V	6867	10316	17560	13096
VI	2876	4999	4766	7011
Total saltcedar	**35460**	**38409**	**45037**	**44843**

a. Anderson and Ohmart, 1976
b: Anderson and Ohmart, 1984
c: Younker and Anderson, 1986
d: Carlson and Salas, pers. comm., 1996 (excludes Lake Mead)

from approximately 8,300 acres in 1976 to 3,400 acres in 1994. However, an additional 1,300 acres became established around 1990 in the Pierce Ferry area of Lake Mead. It should be noted that it is difficult to compare the 1994 data to previous years as the 1994 data do not cover the entire floodplain due to limited aerial photo coverage. However, all of the cottonwood-willow associations should be included as they only occur directly adjacent to the River itself and along the Bill Williams River. Also, each survey was conducted by different contractors so subjective errors are possible, especially in classifying structure type. From 1976 to 1981, there was a decrease in cottonwood-willow types I-III (CW I-CW III) from 941 acres to 755 acres which remained relatively steady until the 1994 survey when the acreage jumped up to 2,052 acres, plus an additional 1,148 acres at Lake Mead (Table 12). Cottonwood-willow types IV-VI (CW IV-CW VI) decreased drastically from 7,220 acres in 1981 to 5,027 acres in 1986 to 1,346 acres (plus 146 acres at Lake Mead). (Anderson and Ohmart 1976;Younker and Anderson 1986; John Carlson and David Salas, USBR, pers. comm.).

These are several possible explanations for the changes in vegetation types along the lower Colorado River. The total numbers changed little from 1976 to 1981 with the exception of the loss of all CW I acres. Flooding from 1978-81 along the Bill Williams River removed the only CW I stand delineated during the 1976 survey (Hunter et al. 1987). The increase in CW I-III acreage since 1986, especially in CW III acreage, is most likely the natural maturing of young cottonwoods and willows which regenerated after the high flow period of the early 1980s. The Gila flood of 1992-93 has regenerated additional acreage in the Yuma and Limitrophe Divisions (Figure 2). The Lake Mead delta area at Pierce Ferry has added an additional 1,148 acres of CW I-III and is made up almost entirely of 10 to 35 foot willows.

Reclamation's current operations and maintenance program should have, when considering the ephemeral nature of habitat in a river ecosystem and native revegetation efforts, minimal direct affect on the river's over all balance of remaining cottonwood-willow stands over the next 5 years. Reclamation's maintenance of river control features is designed to avoid the removal of native trees and such avoidance will be employed during this section 7 consultation. Some of the CW V-VI could be lost due to the lack of surface water, especially south of Morales Dam. The Lake Mead delta willows are susceptible to flooding but have shown resiliency after being inundated over 13 months during previous high water periods. If Lake Mead is kept above the 1,180 foot elevation for 2 years or more, most of these willows will, in all likelihood, die. Conservation efforts undertaken by Reclamation, in cooperation with the four national wildlife refuges along the river, will help replace the important cottonwood-willow type along the lower Colorado River. By working together, Reclamation and the refuges have considerable opportunity in revegetating significant acreages of refuge lands and marshes with present consumptive use allocations.

Current river operations and maintenance do preclude the establishment of newly regenerated cottonwood-willow stands. These species require annual flooding to regenerate and survive to maturity. There have been two periods of high flow in the last 15 years which have created new cottonwood-willow stands, especially in the Yuma Division. However, flood control is a mandated activity for Reclamation. In instances where a surplus of water may be declared, water may be released from Hoover Dam for beneficial use downstream. There are few areas, however, which could benefit from a "controlled flood" such as occurred downstream of Glen Canyon Dam in 1996. Most of the lower Colorado River is lined with municipalities and agricultural lands.

Saltcedar acreage has also increased since 1976. Most of the increase is in the small size classes (SC IV-VI) with the larger SC I-III at the 1976 level (Anderson and Ohmart 1976; John Carlson and David Salas, USBR, pers. comm.). The SC I-III classes may have more potential as southwestern willow flycatcher breeding habitat (Anderson and Ohmart

1977). Reclamation activities should not affect saltcedar types significantly.

The implementation of the requirements of the Law of the River has altered the natural flood regime needed for regeneration of native riparian plant species. The construction of the dams along the lower Colorado River produced a scenario more conducive to the establishment of saltcedar at the detriment of native riparian species. Although saltcedar was present in the system before the major impoundments occurred, there is little doubt that its dominance is due to the elimination of the natural flood regime (Ohmart et al. 1988) and fires (Busch 1995). The effects to southwestern willow flycatcher are largely unknown since it is unsure whether the flycatcher can utilize saltcedar effectively for breeding.

Although there is no empirical evidence that Reclamation is directly affecting this endangered species, it is reasonable to conclude that current ongoing operations and maintenance may affect the species through unknown and unquantifiable events of disturbance of the species and potential, temporary habitat modification.

Indirect Effects - Indirect effects associated with Reclamation's current operations and maintenance along the lower Colorado River are limited. Many of the activities which provide impetus to increased growth of municipalities, increased recreational use (and subsequent increase in fire activity), or land conversion to agriculture are non-Federal activities. Reclamation must, by law, provide water to the States. The current operation and maintenance of the river enables Reclamation to meet this obligation.

The historical and recent trend in the decline of native cottonwood-willow habitat has been described in the description of the environmental baseline and in the preceding discussion. In terms of indirect impacts occurring later in time, there is a possibility, exclusive of flood and surplus water events, that ongoing river operations could contribute, in part, along with fire, land conversion, and lack of surface water, to the continued decline of this native habitat along the lower Colorado River flood plain. This trend, over time, may, depending on the success of breeding in saltcedar, affect an unquantifiable number of migratory or breeding southwestern willow flycatchers.

Cumulative Effects - Riparian areas in the Southwest have been drastically affected by human activity since the mid-1800s. Mearns (1907) estimated between 400,000 and 450,000 acres of riparian vegetation was present along the lower Colorado River south of Fort Mohave to Fort Yuma. Today, there is approximately 100,000 acres of riparian vegetation south of Davis Dam, much of which is occupied by saltcedar (Younker and Anderson 1986). Riparian ecosystems throughout the Southwest have been altered due to impoundments, overgrazing, mining, and conversion to agriculture (Phillips et al. 1964; Johnson and Haight 1984; Unitt 1987; Rosenberg et al. 1991; Tibbitts et al. 1994).

Conversion of riparian lands to agriculture began around the turn of the century, expanding rapidly after the passage of the Reclamation Act of 1902 (LaRue 1916; Wilbur and Ely 1948; Lower Colorado Region State-Federal Interagency group 1971). Most agricultural conversion along the lower Colorado River had occurred by 1976 (Ohmart et al. 1988). The loss of 300,000 acres of riparian habitat to agriculture along the lower Colorado is one of the key reasons why the southwestern willow flycatcher is listed as an endangered species.

The Congressionally-mandated control of the Colorado River brought about a boom in recreational activities along the lower Colorado River. These recreational activities, combined with the increased presence of saltcedar in the ecosystem, have greatly increased the occurence of wildfire. Fire has a much greater detrimental effect on native riparian plant species than on saltcedar. The end result of most fires along the lower Colorado is the loss of native riparian species (Busch 1995).

Other portions of the southwestern willow flycatcher range have been or are being affected by many of the same problems, as well as other problems not associated with the lower Colorado River ecosystem. One of the major concerns in other portions of its range is overgrazing. Overgrazing has affected species composition and stand structure in riparian areas utilized by southwestern willow flycatcher for breeding. Cowbird parasitism has increased due to habitat fragmentation and increased foraging habitat created by livestock (Klebenow and Oakleaf 1984; Taylor 1986; Taylor and Littlefield 1986; Tibbitts et al. 1994).

The result of actions incurred over the last century throughout the Southwest on the southwestern willow flycatcher have created the needed for its listing as an endangered species (60FR10694). Along the lower Colorado River, the southwestern willow flycatcher was fairly common at the turn of the century (Grinnell 1914; Unitt 1987). Today, its numbers are unknown. Throughout its range, there may only be 230-500 nesting pairs remaining (58FR39495). As of June 1996, FWS has consulted on over twenty projects within the range of the southwestern willow flycatcher and has found a "No Effect" on only 4 of 14 projects in which the consultation process has been concluded (Table 13).

2. Threatened

a. Bald Eagle (*Haliaeetus leucocephalus*)

Description and Life Requisites

The bald eagle is a large, powerful brown raptor with a white head and tail. Bald eagles do not reach full adult plumage until they are 4 to 6 years of age. Immature birds younger than 4 years old are primarily brown with some white mottling. The bald eagle is the only member of the sea eagle family regularly occurring on the North American continent.

A bird of aquatic ecosystems, it frequents estuaries, large lakes, reservoirs, major rivers, and some seacoast habitats. In winter, bald eagles often congregate at specific wintering sites

Table 13. Agency actions that have undergone section 7 consultation and levels of Incidental Take permitted for the Southwestern Willow Flycatcher range wide.

Action	Federal Agency	Incidental Take Anticipated
Arizona		
Glen Canyon Spike Flow (Coconino Co.)	USBR	Loss of Proposed Critical Habitat
Solomon Bridge (Graham Co.)	FHWA	Loss of 2 Territories
Eastern Roosevelt Lake Watershed Allotment (Maricopa Co.)	Tonto NF	Indeterminable
Tonto Creek Riparian Unit (Maricopa Co.)	Tonto NF	Indeterminable
Modified Roosevelt Dam (Gila/Maricopa Co.)	USBR	Consultation in progress
U.S. Hwy 93 Wickenburg (Mohave Co.)	FHWA	Consultation in progress
Romero Road Bridge (Pinal Co.)	FEMA	Consultation in progress
Grazing on 13 Allotments (Pinal Co.)	BLM	Consultation in progress
Cedar Bench Allotment (Yavapai Co.)	Tonto NF	Indeterminable
Tuzigoot Bridge (Yavapai Co.)	NPS	None
Verde Valley Ranch (Yavapai Co.)	Corps	Loss of 2 Flycatcher Territories
Windmill Allotment (Yavapai Co.)	Coconino NF	Loss of 1 Flycatcher Nest Annually
Lower Gila Resource Plan Amend. (Yuma Co.)	BLM	Consultation in progress
White Canyon Fire (Pinal Co.)	BLM	Unknown
California		
Lake Isabella Operations (Kern Co.)	Corps	Consultation in process
Orange County Water District (Orange Co.)	Corps	None
Prado Basin, (Riverside/San Bernardino Co.)	Corps	None
Temescal Wash Bridge (Riverside Co.)	Corps	Harm to 2 Flycatcher Individuals

Camp Pendleton Cooperative Agreement (San Diego Co.)	DOD	Loss of 4 Flycatcher Territories
Nevada		
Gold Properties Resort (Clark Co.)	BIA	Harassment of 1 Flycatcher via Habitat Loss
New Mexico		
Corrales Unit, Middle Rio Grande (Bernalillo Co.)	Corps	None

that are generally close to open water and that offer good perch trees and night roosts (59FR35584 1994). They prey mainly on fish but also eat birds, mammals and carrion fish.

Distribution and Abundance

The bald eagle historically ranged throughout North America except extreme northern Alaska and Canada and central and southern Mexico. Bald eagles nest on both coasts from Florida to Baja California, in the south, and from Labrador to the western Aleutian Islands, Alaska, in the north. World population estimates range as high as 80,000 bald eagles (Stalmaster 1987), with up to 20,000 eagles wintering in the contiguous United States (Gerrard 1983).

In 1978, in response to lowering population and reproductive success, FWS listed the bald eagle throughout the lower 48 states as endangered except in Michigan, Minnesota, Wisconsin, Washington, and Oregon, where it was designated as threatened (43FR6233, February 14, 1978). In the 18 years since it was listed, the bald eagle population has clearly increased in number and expanded its range. This improvement is a direct result of the banning of DDT and other persistent organochlorines, habitat protection, and from other recovery efforts (60FR36001, July 12, 1995). On August 11, 1995, FWS reclassified the bald eagle from endangered to threatened in the lower 48 states. This reclassification also included the southwestern population (including Arizona) which was determined not be reproductively isolated as previously believed (60FR133, pg 3600, August 12, 1995).

Little was known about the bald eagle in Arizona (and the project area) prior to 1972 when the FWS began monitoring the population (Rubink and Podborny 1976). For many years, the unique desert nesting birds of Arizona were thought to be reproductively isolated. In 1982, a recovery plan was developed specifically for the southwestern bald eagle. The geographic boundaries of this population as defined by the recovery plan includes Arizona, New Mexico, portions of Texas and Oklahoma west of the 100th meridian, and southeast California within 10 miles of the Colorado River or its reservoirs.

In 1987-1990, Biosystems Analysis, Inc., investigated the ecology of Arizona's nesting population of bald eagles. The study was funded by Reclamation for the purpose of determining what factors limit the Arizona eagles, and particularly whether the reservoirs and regulated flows produced by construction and operation of water projects have been harmful or beneficial. Hunt et al. (1992) was an extremely comprehensive look into the biology and ecology of this raptor which will likely be used and cited by resource managers and researchers for decades to come.

Most of those who studied bald eagles previously in Arizona believed that reservoirs were relatively unimportant as foraging habitat. Rubink and Podborny (1976) speculated that, "Large reservoirs may be unsuitable as foraging habitat. Several reasons are possible: inadequate perches and shallow water areas, the absence of fish near the surface, turbidity of the water or human disturbance by boating." However, Hunt et al. (1992) concluded that bald eagles on the Salt and Verde River systems of Arizona often perched and foraged at reservoirs. Not only did nesting eagles frequently perch at reservoirs, they foraged on them extensively. Of 841 forage attempts recorded at the 7 studied territories by Hunt et al (1992), 435 (51.7%) occurred on rivers and 406 (48.3%) on reservoirs. Overall, reservoirs, dams, or regulated river reaches did not appear to have a negative effect on bald eagle reproduction. In habitats altered by dam construction, 134 young fledged from 12 sites in 122 occupied nest years for a mean of 1.1 young per year. In "natural" habitats, the eagles produced 93 young at 9 sites in 92 nest-years, for a mean of 1.0 young. The difference in productivity between altered and unaltered habitat was not significant(Hunt et al. 1992).

On reservoirs, most observed eagles foraged for fish in deep water and most were taken as carrion or as they floated moribund on the surface. Hunt et al. (1992) documented eagles foraging on a number of non-native species on reservoirs including carp, black crappie, yellow bass, largemouth bass, and catfish. Two factors which appear to strongly increase habitat quality included "reservoirs supporting warm water fisheries" and "reservoir inflow areas" (Hunt et al. 1992).

Busch (1988) commented that "Although potential cliff nest sites appear to be abundant in Arizona and New Mexico, the bald eagle's proclivity toward tree nests throughout its range may indicate that cliff nests are only marginally suitable." Hunt et al. (1992), however, found that bald eagles nested on cliffs and in trees. Of the 11 known nests within the 28 breeding areas known at the time of the study, 36 were on cliffs, 17 on pinnacles, 46 in trees, 11 in snags, and 1 was built on an artificial nesting platform. Of the 11 cumulative years of data on active nests, Biosystems, Inc. also found that at breeding areas where both cliff and nest trees were available, eagles selected cliff nests 73 percent of the time and tree nests 27 percent. More significantly, Hunt et al. (1992) found no significant difference in the nesting success between cliff nests (65% successful) and tree nests (57% successful).

No data exists to indicate that the lower Colorado River was a significant breeding area for bald eagles. Historical records of breeding are rare. In 1975 a nest was built in a cottonwood tree on Havasu National Wildlife Refuge (Hunt et al. 1992). No eggs were laid in 3 years of monitoring, and the breeding area was not included as a known breeding area by Hunt et al. (1992) or Driscoll (1994). The site was checked by the AGFD in 1994 and 1995. While the Havasu tree nest still exists, no eagles were observed in either year (Greg Beatty, AGFD, pers. comm.). An unverified report of a cliff nest 15 miles upstream of Davis Dam also exists (Hunt et al. 1992). On April 18, 1996, a large eagle-sized cliff nest was found at Gene Wash Reservoir in California approximately 1 mile west of Parker Dam. Sightings of bald eagles at Gene Wash and the Copper Basin Reservoir to the west strongly suggest that this is a new bald eagle breeding area (AGFD letter, May 15, 1996).

Rosenberg et al. (1991) described the bald eagle along the Colorado River as a "rare to uncommon winter visitor, increasing in some years after midwinter." However, based on data from bald eagle winter counts (1992-1996) conducted by the AGFD, eagles can certainly not be considered rare within the project area. In 1993, 13 eagles (subadults and adults) were counted, 15 in 1994, 6 in 1995, and 13 in 1996. In both 1995 and 1996, 11 eagles were counted in the Temple Bar area of Lake Mead. Because these counts were conducted over a short time, they should be considered the minimum number of wintering birds using the lower Colorado River.

Two nesting pairs inhabit the Bill Williams River near Alamo Dam, and it is possible the dispersing young or wide-ranging foraging adults may be seen during spring and summer along the Colorado River. At least some of the wintering birds are known to be from the Arizona breeding population. In 1988, a radio-tracked fledgling from the Verde River, Arizona, was followed to British Columbia and then reappeared at Martinez Lake in December of the same year (Rosenberg et al. 1991).

Effect Analysis

Direct Effects - Current river operations and maintenance may preclude the establishment of newly regenerated cottonwood/willow stands that could provide future nesting and perching substrate for eagles. However, as documented in Hunt et al. (1992) and by the potential Gene Wash Reservoir nesting territory, bald eagles can successfully nest on other substrates (cliffs, pinnacles).

Still, Reclamation's ongoing native riparian plant restoration program has the potential to increase available tree nesting and perching habitat along the river. No evidence exists to suggest that the food resources available in the reservoirs and river are limiting nesting within the project area.

Human disturbance is a cumulative effect associated with recreational use of shorelines and waterways that has the potential to degrade bald eagle habitat. However, steps to reduce such human-induced disturbances are underway by all levels of government and numerous private conservation organizations nationwide.

The Arizona Nest Watch Program, established in 1978, has been a positive force in preserving bald eagles in Arizona. It is well known that the presence and activities of the nest watchers has resulted in a substantial increase in breeding success (Hunt et al. 1992). Efforts to coordinate inter-agency programs to monitor, protect, and educate the public on the bald eagle are actively overseen by the Southwest Bald Eagle Management Committee. Federal agencies often implement closures around bald eagle nests to manage human disturbance, and the committee provides recommendations on closure programs when requested.

Reclamation has nearly completed its obligations to implement section 7 consultation measures for bald eagles from impacts from its projects in Arizona. However, Reclamation is committed to continued support of the Arizona Nest Watch Program and associated activities through the section 7 (a)(1) program. Reclamation funding of $50,000 per year is programmed for the nestwatch program and to assist AGFD in survey and band reading projects.

Reclamation believes that river operations and maintenance activities are not likely to adversely effect the food resources, foraging opportunities, or the nesting habitat of the bald eagle within the project area. The potential new territory at Gene Wash Reservoir will not be impacted by potential flood flows on the Colorado River. The reservoir, owned and operated by MWD, is managed for a stable pool year round, and no drawdown during the breeding season is anticipated. The reservoir is also fenced and access is restricted. Wintering birds are expected to continue using the river and most likely will congregate where food resources are plentiful and excessive disturbance from recreation can be avoided. Reclamation, and most likely other Federal and State resource management agencies, will continue to coordinate with the Southwestern Bald Eagle Management Committee and the Arizona Bald Eagle Nestwatch Program to ensure that nesting territories are protected to the greatest extent possible. It is our opinion, that river operation and maintenance activities over the next 5 years will not affect the bald eagle.

b. Desert Tortoise (*Gopherus agassizii*) (Mojave & Sonoran populations)

Description and Life Requisites

The desert tortoise occupies a variety of habitats throughout its range. In the Sonoran Desert of Arizona, the tortoise typically occurs in the palo verde-cacti-mixed scrub series (Barrett and Johnson 1990). Range wide, desert tortoises are typically found at elevations of 6,000 to 3,500 feet. In Arizona, they have been found as low as 500 feet (Mohave valley, Mohave County) and as high as 5,200 feet (east slope of the Santa Catalina Mountains, Pima County). Sonoran tortoise shelter sites (dens, pallets, etc.) most often occur on rocky bajadas and slopes or in washes that dissect the desert scrub and include cavities in sides of washes, crevices beneath rocks and depressions under shrubs. Sonoran tortoises often use more than one den (Holm 1989; Barrett and Johnson 1990) and re-use previously occupied dens. They appear to avoid the deep, fine soiled valley situations favored by western Mojave tortoises. Nest sites are nearly always associated with soil at the mouth of shelter sites.

The Mojave population of desert tortoise occurs primarily on flats and bajadas with soils ranging from sand to sandy-gravel, characterized by scattered shrubs and abundant inter-space for growth of herbaceous plants. They occur in creosote bush, alkali sink, and tree yucca habitats in valleys, on alluvial fans, and in low rolling hills at elevations ranging from sea level to 4,000 feet. They appear to prefer bajadas and desert washes where soils range from sandy-loam to light gravel-clay which are optimal for burrow construction. Shelter sites often occur on lower bajadas and basins in burrows dug in soil, cavities in sides of washes and depressions under shrubs. Important food items of the Sonoran tortoise are similar to those of the Mojave tortoise and include various species of forbs, grasses, succulents, and shrubs.

In general, downward trends in desert tortoise numbers and habitats result from urban development, long-term livestock grazing, mining, off-highway vehicle use, and collecting. Mortimore and Schneider (1983) suggested a Nevada die-off in the early 1980s was due in part to drought conditions and that habitat had been adversely impacted by long-term grazing intensities. D'Antonio and Vitouseki (1992) indicate that the increasing incidence and severity of fires combined with changes in vegetative community types, primarily towards exotic ephemerals, have adversely effected desert tortoises. Habitat fragmentation is another major contributor to population declines (Berry 1992). Populations have been fragmented and isolated by urban development, highway construction, and development within powerline corridors.

The most serious problem facing the Mojave population of the desert tortoise is the "cumulative effects of human and disease-related mortality accompanied by habitat destruction, degradation, and fragmentation" (FWS 1994).

Human contact includes a number of threats. Among the most common are collection for food, pets. commercial trade, and medicinal uses, as well as being struck and killed by on-and-off road vehicles. Still another is by gunshot. Berry (1990) found that between 1981-1987, 40 percent of the tortoises found dead on a study plot in Freemont Valley, California, had been killed by gunshot or by off-road vehicles (FWS 1994).

Predation is another factor. Hatchlings and juveniles are preyed upon by several native species of reptiles, birds, and mammals, as well as by domestic and feral dogs. Predation by ravens is intense, as their population has grown over the last few decades due to increased food supplies provided by human development. Berry (1990) believes that predation pressure by ravens in some portions of the Mojave is so great that recruitment of juveniles into the adult population has been halted.

Disease has been noted as a factor since 1990. An upper respiratory tract disease has been discovered and is currently a major cause of mortality in the western Mojave Desert population. Predisposing factors, such as habitat degradation, poor nutrition, and drought, have only served to compound the problem (FWS 1994).

Habitat destruction, degradation, and fragmentation are yet some other threats. Over the last 150 years, there have been substantial decreases in perennial grasses and native annuals and an increase in exotics, which serve as fire hazards. Perennial shrubs and grasses used for cover and food have been diminished and have been replaced by inedible exotic ephemerals. Also, as the habitat becomes increasingly fragmented, desert tortoises are forced to forage over larger areas and are thus exposed to greater dangers. Finally, grazing by domesticated animals damages the soil, reduces water filtration, promotes erosion, and invites invasion by exotic vegetation (FWS 1994).

Distribution and Abundance

The desert tortoise has a rather extensive range in the Mojave and Sonoran Deserts of the United States and Mexico. Tortoise populations occurring in the Mojave and Sonoran deserts are for the most part isolated from each other by the Colorado River.

Sonoran Population:

Arizona's Sonoran population of the desert tortoise occurs discontinuously south and east of the Colorado River, from Lake Mead National Recreational Area through the southwest, westcentral and southcentral parts of the State. The precise range limits are generally not well known, and there are frequent occurrence information gaps within the known or suspected limits. The distribution map prepared by Johnson et al. (1990) (see Figure 29), represents known areas of Sonoran tortoise occurrence within Arizona. Within this estimated 68,228 acres of occupied habitat, actual occurrence depends on local habitat parameters and other factors affecting tortoise populations. Available data indicate the range of the desert tortoise has not been reduced in Arizona in recent times (Barrett and Johnson 1990).

Mojave Population:

The Mojave desert tortoise population, including both the western and eastern subpopulations, occurs (generally) in eastern California, southern Nevada, and the Beaver Dam Slope and the Virgin River Basin of southwestern Utah and extreme northwestern Arizona. These areas include portions of both the Mojave and Sonoran deserts. Within the Mojave region, the Mojave Desert is represented in parts of Inyo, Kern, Los Angeles, San Bernardino, and Riverside Counties in California; the northwestern part of Mohave County in Arizona; Clark County, and the southern parts of Esmeralda, Nye, and Lincoln Counties in Nevada; and part of Washington County, Utah. The Colorado Desert, a division of the Sonoran desert, is located south of the Mojave Desert and includes Imperial County and parts of San Bernardino and Riverside Counties, California.

Effect Analysis

Direct Effects - Potential direct effects to desert tortoises from activities associated with river operations, such as flow releases, are not expected to occur since tortoises are not expected to occupy areas in close proximity to the river channel. Furthermore, no river maintenance activities such as bankline stabilization, levee maintenance, or dredging activities are anticipated in areas along the lower river where desert tortoises are known or expected to occur. All existing bankline and levee roads are either immediately adjacent to the river and/or within previously disturbed agricultural and/or urban areas and, hence, not within suitable tortoise habitat.

Indirect Effects - Other than quarry activities, no future interrelated and/or interdependent activities associated with river operations and/or maintenance activities along the lower Colorado River are anticipated which may have an effect to desert tortoises. Section 7 consultation for all future proposed quarry operations (including proposed or existing haul roads) is presently underway (Reclamation Memorandum to FWS dated April 2, 1996). Effect determinations concerning these activities will be made through this separate consultation effort. [The "Palo Verde " quarry (south of Palo Verde, California) has an immediate need for use and will be consulted on separately. Biological surveys were conducted the week of July 8, 1996. Endangered species effect determinations will be made and consultation with the FWS will be conducted prior to quarry activities. The use of this quarry is needed to finish work associated with the Three-Fingers Lake wildlife enhancement initiative.]

Cumulative Effects - Future, non-Federal activities occurring within the action area and which may effect (extent unknown) desert tortoises include recreational activities (e.g., off-road vehicles), agricultural development (land conversion), municipal development (land conversion), road and utility corridors, mining, grazing, and fire.

3. Proposed Threatened

Flat-tailed horned lizard (*Phrynosoma m'callii*)

Description and Life Requisites

The flat-tailed horned lizard has the typical flattened body shape of horned lizards. It is distinguished from other species in its genus by its dark vertebral stripe and lack of external ear openings (Funk 1981). Compared to other horned lizards, it has a longer, broader, flatter tail. The flat-tailed horned lizard has two rows of fringed scales on each side of its body. The species is cryptic in color, ranging from pale gray to light rush brown dorsally, and white or cream (unspotted) ventrally with a prominent umbilical scar.

Most records for flat-tailed horned lizards come from the creosote (*Larrea tridentata*)-white bursage (*Ambrosia dumosa*) series of Sonoran desertscrub (Turner and Brown 1982). It is this open community in association with sandy flats and valleys that is often described as flat-tailed horned lizard habitat (Stebbins 1966, Turner and Medica 1982, Rorabaugh et al. 1987). In Arizona, the presence of big galleta grass (*Hillaria rigida*) was correlated with flat-tailed horned lizard abundance and may be an important vegetative component of flat-tailed horned lizard habitat (Rorabaugh et al. 1987).

Approximately 97 percent of the diet of the flat-tailed horned lizard consists of ants (Parker and Pianka 1975, Turner and Medica 1982). The most important ant species are harvester ants in the genera *Veromessor* and *Pogonomyrmex* (Turner and Medica 1982).

Flat-tailed horned lizards are oviparous and early maturing, and they may produce multiple clutches (Howard 1974). Two cohorts of hatchlings are produced each year, in late July and in September (Muth and Fisher 1992). Hatchlings from the first cohort in July may reach sexual maturity after their first winter season, whereas hatchlings born in August may require an additional growing season (Howard 1974).

Unlike other iguanid lizards that flee when approached, flat-tailed horned lizards generally remain still. Flat-tailed horned lizards spend 54 percent of the day in some form of movement (Muth and Fisher 1992). Most activity occurs during the mid-day in spring and fall, but as summer temperatures increase, the activity period is split between morning and evening (Mayhew 1968). Other behavioral characteristics are documented in Klauber 1939, Rorabaugh 1994, Mayhew 1965, Howard 1974, Smith and Ballinger 1994, Schmidt-Nielsen 1964.

Distribution and Abundance

The flat-tailed horned lizard is found in the extreme southwestern corner of Arizona, the southeastern corner of

California, and adjoining portions of Sonora and Baja California, Mexico.

In Arizona, the flat-tailed horned lizard is found in southern Yuma County, primarily south of Interstate 8 and west of the Gila Mountains. Rorabaugh et al. (1987) and Johnson and Spicer (1985) estimated that as of 1987 the flat-tailed horned lizard inhabited from 245 to 277 square miles in Arizona. Suitable flat-tailed horned lizard habitat is east and south of the City of Yuma, Arizona, outside of the Colorado River floodplain.

The flat-tailed horned lizard is found in California in portions of eastern San Diego County, central Riverside County, and Imperial County. The majority of the habitat for the species is in Imperial County (Turner and Medica 1982). The range of the flat-tailed horned lizard encompasses approximately 2,847 square miles in California (Bolster and Nicol 1989, Rado 1981).

Threats to the flat-tailed horned lizard result primarily from habitat destruction for urbanization and agricultural development. Other activities which have the potential to impact habitat include power transmission lines, transportation construction (roads, railways, etc.), and off-road vehicle use. Additional threats to the species include direct mortality from vehicular traffic, both on and off road.

As a result of the Flat-Tailed Horned Lizard Range wide Management Strategy, which Reclamation is a participating member, Reclamation has proposed to preserve approximately 16,000 acres within the 5-mile zone as a flat-tailed horned lizard preserve and has agreed to no new land use within the preserve boundaries. However, Reclamation would reserve the right to maintain the existing 242 well field authorized by Public Law 93-320. Reclamation would also reserve the right to expand the well field, but expansion would be closely coordinated with the FWS in regards to possible impacts to the flat-tailed horned lizard. Mitigation features would be those outlined in the range wide management strategy. Reclamation will actively implement the management actions outlined in the strategy to minimize loss or degradation of habitat in that area.

Effect Analysis

Effects of Reclamation's discretionary activities within the flat-tailed horned lizard habitat are found within the 5-mile zone located south of Yuma, Arizona. The 5-mile zone consists of 36,000 acres and is located approximately 10 miles south of Yuma Arizona. The zone extends about 13 miles east from U.S. Highway 95 on the west and north, and 5 miles from San Luis, Arizona, to slightly north of Gadsen, Arizona. The northern boundary parallels the SIB. The 5-mile zone contains Reclamation-acquired land, which was obtained for construction, operation and maintenance of the 242 well field for use in Arizona.

Direct Effects - Reclamation's activities in the 5-mile zone are limited to operating and maintaining the well field and operating the YDP sludge disposal site. In addition, Reclamation maintains the canal for the delivery of pumped water to Mexico in compliance with the 1944 Treaty.

Direct effects to the flat-tailed horned lizard from the above activities would include mortalities from maintenance vehicles along the access road to the well field and associated canal, and vehicles working within the sludge disposal site.

Indirect effects - Reclamation is a member of the Flat-Tailed Horned Lizard Interagency Coordinating Committee and is assisting in the preparation of the Flat-Tailed Horned Lizard Range wide Management Strategy. The goal of the program is to maintain viable populations of flat-tailed horned lizards for the next 100 years.

As stated before, Reclamation has proposed to dedicate approximately 16,000 acres of flat-tailed horned lizard habitat within the 5-mile zone as a preserve. In addition, Reclamation will actively implement the management outlined in the Management Strategy to reduce or eliminate indirect impacts of future discretionary actions within the 5-mile zone.

Over the next 5 years, no new construction by Reclamation is anticipated in the area.

Cumulative Effects - Cumulative effects are defined for this purpose as effects of future State, local, or private actions that are reasonably certain to occur within the action area.

Cumulative effects to the flat-tailed horned lizard in the 5-mile zone are the same as those described above, primarily mortality from vehicular traffic.

Activities underway in the 5-mile zone other than those described above include:

- Operation of County of Yuma Auxiliary 4 Airport - This is an old military airstrip which is presently used primarily for "touch and go" landing exercises. There are no facilities at the airstrip, and on-the-ground activities are primarily repair of the paved areas of the airstrip.

- City of Yuma Landfill - Operations at this landfill would include normal landfill operations, with the associated vehicular traffic to and from the landfill.

- Hillander C Irrigation District - This is a privately owned irrigation district within the 5- mile zone. Farming activities are conducted within the confines of the district, with associated vehicular traffic to and from the area.

- Cattle Crossing and Holding Facility - This facility straddles the U.S./Mexico border. It functions as a quarantine holding facility for cattle being shipped into and out of Mexico.

- Sonora Substation and Transmission Lines owned by Arizona Public Service - These are public utility facilities which undergo periodic maintenance and inspection.

- Arizona State Minimum Security Prison - This facility is operated by the State of Arizona as a minimum security prison, and activities are primarily conducted within the facility confines. Security patrols may occur around the perimeter of the property.

- U.S. Immigration and Naturalization Service (INS) - The INS patrols the 5-mile zone and adjacent areas to prevent illegal entry into the United States

Based on the above analysis, it may be concluded that Reclamation's activities may affect, but not adversely affect, the flat-tailed horned lizard.

4. Sensitive*

a. California Leaf-Nosed Bat (*Macrotus californicus*)

Description and Life Requisites

No other large-eared bat in the area has a nose-leaf (erect and lanceolate), and no other bat with a nose-leaf has such large ears (1 to 1.5 inches). In various places in Arizona and along the Colorado River in California, California leaf-nosed bats are known to feed on short-eared and long-eared grasshoppers, long-horned beetles, cicadas, sphinx moths, and noctuid and cossid moths (Hoffmeister 1986).

The California leaf-nosed bat is found in southern California and southern Nevada, across the southwestern half of Arizona, and southward to the southern tip of Baja California, northern Sinaloa, and southwestern Chihuahua, Mexico. In Arizona it is primarily a cave and mine dweller, mostly in the Sonoran desert scrub. These bats can remain active year round and do not hibernate or migrate (Hoffmeister 1986). Specimens examined by Hoffmeister (1986) were from Yuma, Parker, and 8 miles north of Parker. This species is susceptible to human disturbance which may cause abandonment of roosts (AGFD 1992).

b. Spotted Bat (*Euderma maculatum*)

Description and Life Requisites

A distinctive, medium sized bat (forearm 1.5 to 2 inches) with three large white spots, one on each shoulder and one at the base of the tail. The ears are pinkish-red and, at nearly 2 inches, the largest of any North American bat. There is only limited information on reproduction biology, but one young is apparently born from late May to early July. Moths are the dominant food item.

Distribution and Abundance

Considered one of the rarest bats in the United States, it is most frequently encountered in California, Arizona, New Mexico, southern Colorado, and southern Utah. However, it is unclear what is the preferred habitat of the species. Findley et al. (1975) believe uneven rocky cliffs within a mile or so of riparian situations is the preferred habitat. Barbour and Davis (1969) suggest that spotted bats are residents of the ponderosa pine area in June and July and migrate to lower elevations in late summer and autumn. The winter range is unknown. In Arizona, specimens are known from Yuma and Roll, Arizona. Roost site characteristics are poorly known, but they are thought to be crevices and cracks in cliff faces.

c. Greater Western Mastiff-Bat (*Eumops perotis californicus*)

Description and Life Requisites

This is the largest bat in the United States and has a forearm 3 to 3¾ inches in length. The distal half of the tail is free from the interfemoral membrane. One young is born as early as June and as late as August. They forage primarily for insects at considerable heights (sometimes to 1,000 feet or more) and for long periods during the night; they especially like Hymenoptera (bees, wasps, ants and sawflies).

Distribution and Abundance

The greater western mastiff-bat is found from San Francisco Bay, California, through Las Vegas, Nevada, the southern half of Arizona to Big Bend, Texas, and south to Sinaloa in northwestern Mexico and Zacatecas in central Mexico. They can be found mostly below 4,000 feet in elevation in the lower and upper Sonoran desert scrub near cliffs, preferring rugged canyons with abundant crevices (AGFD 1992). The foraging range apparently is extensive. Vaughan (1959) has reported hearing this bat flying over desert flats several miles from the nearest likely roost site. In the Mohave Desert they were heard foraging 15 miles from the nearest hills (Barbour and Davis 1969). Specimens examined by Hoffmeister (1986) were from two locations west of Kingman in Mohave County.

d. Small-Footed Myotis (*Myotis ciliolabrum*)

Description and Life Requisites

The small-footed myotis is identified by its glossy fur, black face mask, and tiny foot (one-third inch). It apparently roosts in crevices and cavities of cliffs and or rocks, and possibly within caves and mine shafts. This species is remarkable in its tolerance for cold, relatively dry places for hibernation, especially for so small a bat.

Distribution and Abundance

This species is most common and widespread in the western half of the United States, ranging from Saskatchewan, Alberta, and British Columbia in Canada south to Chihuahua in Mexico. In Arizona, it can be found most anywhere except for southwestern deserts of Sonoran desert scrub. Little information is known about the small-footed myotis in Arizona. It has been found in a variety of habitats including chaparral, riparian areas with oak and juniper, and from the lower edge of the oak belt (AGFD 1992).

e. Allen's (Mexican) Big-Eared Bat (*Idionycteris phyllotis*)

Description and Life Requisites

This is a rather large (forearm 1.5 to 2 inches) bat with enormous ears, a broad tragus, and a unique pair of lappets projecting from the median bases of the ears anteriorly over the top of the snout.

Distribution and Abundance

In the United States, the species is known to inhabit westcentral New Mexico across Arizona to the Colorado River valley, mostly at higher elevations. The winter range is unknown. In general, this bat inhabits forested areas of the mountains. In Arizona, it has been found in ponderosa pine, pinyon-juniper, Mexican woodland, white fir forests, and Mohave desert scrub. It is not known to inhabit the southwestern deserts of Arizona. They use mine tunnels for roosting, and both tunnels and boulder piles for nursery colonies (AGFD 1991).

f. Pale Townsend's Big-Eared Bat (*Plecotus townsendii pallescens*)

Description and Life Requisites

This medium-sized bat (forearm 1.5) has large ears measuring more than an inch in length. Two large lumps appear on the dorso-lateral surface of the snout (Barbour and Davis 1969). Foraging primarily on small moths, they may forage several miles (4 to 5 miles) from the roost site (caves and mines).

Distribution and Abundance

This species is found at all seasons throughout its range from sea level to 9,600 feet (Barbour and Davis 1969). It is only infrequently found in the desert mountains of Arizona (Hoffmeister 1986). Townsend's big-eared bats are to be found during the day mostly in caves or mine tunnels, but at night they often rest in abandoned buildings (Hoffmeister 1986). Although widespread in Arizona, it is not common anywhere else. Hoffmeister (1986) lists one specimen taken 8 miles north of Parker.

g. Long-Legged Myotis (*Myotis volans*)

Description and Life Requisites

This is the only large western myotis with a well developed keel on the calcar (forearm, 1 to 1.5 inches). Feeding primarily on moths, it forages over ponds, streams, open meadows or forest clearings. Night roosts are usually in caves or mines.

Distribution and Abundance

It occurs widely over the western United States from Alaska to Vera Cruz and east to the Great Plains. In Arizona, it occurs in the pinyon-juniper, oak, and conifer forested areas throughout northern Arizona and central and southeastern Arizona. Specimens examined by Hoffmeister (1986) were from near Kingman in Mohave County.

h. Fringed Myotis (*Myotis thysanodes*)

Description and Life Requisites

This bat is the only myotis in the United States with a conspicuous fringe of hair along the posterior border of the interfemoral membrane (forearm 1.5 to 2 inches). The fringed myotis roosts in caves, abandoned buildings, rock crevices, and trees.

Distribution and Abundance

It can be found in western North America from British Columbia south to Vera Cruz and Chiapas in Mexico. Fringed myotis are found from chaparral to ponderosa pine, but the preferred habitat is probably the oak woodland from which they forage out into a variety of other habitats(Hoffmeister 1986). Although it usually occurs at elevations of 4,000-

7,000 feet, it ranges down to sea level on the west coast. Little is known about winter habits. Specimens examined by Hoffmeister (1986) were from Mohave County from Union Pass east to Kingman and the Hualapai Mountains.

i. Yuma Myotis (*Myotis yumanensis*)

Description and Life Requisites

A rather small myotis (forearm 1 to 1.5 inches) found in western North America from British Columbia south to Hidalgo and Michoacan in Mexico. This bat seems to be more closely associated with water than any other North American species. Large nursery colonies can be found in buildings, under bridges, and in caves and mines.

Distribution and Abundance

Yuma myotis are found in summer in those parts of Arizona where water is present over which they forage for food, such as along the Colorado and Little Colorado Rivers, irrigation canals, and permanent ponds, streams, and creeks. The winter range in Arizona is known only from along the lower Colorado River. Specimens examined by Hoffmeister (1986) were from Ehrenberg, Davis Dam, Yuma, Gadsen, and north of Parker, Arizona.

j. Cave Myotis (*Myotis velifer*)

Description and Life Requisites

This bat is a large myotis with a bare patch on the back between the shoulder blades. They roost in caves, tunnels, mine shafts, under bridges, and sometimes in buildings within a few miles of water. It is highly colonial and is often found roosting with the freetail bat, *Tadarida braseliensis*, and the Yuma myotis.

Distribution and Abundance

This species ranges from southwestern United States at lower elevations from Kansas to southern Nevada and southeastern California, and southward through Mexico to Honduras (Barbour and Davis 1969). In Arizona, the cave myotis ranges south of the Mogollon Plateau from southern Mohave County southeastward. Winter range is mostly in the southeastern corner of the state (Hoffmeister 1986). In Arizona its primary habitat is desert scrub of creosote, brittle bush, palo verde and cacti. Cave myotis have been collected near the Colorado River at Empire Flat in the Buckskin Mountains and along the river at Ehrenberg, Arizona (AGFD 1992).

Effect Analysis for all Above Discussed Bat Species

Quarry activities have the potential to impact bats that may roost in associated rock crevices, mine shafts, adits, etc. However, no known roosts occur within any of the quarry sites along the Colorado River. If roosts are discovered during mining operations, Reclamation will halt such activities and seek the assistance of the AGFD, NDOW, and CFG to develop an appropriate mitigative measure to protect the roost. Other river operations will not likely impact these bat species.

k. Yuma Hispid Cotton Rat (*Sigmodon hispidus eremicus*)

Description and Life Requisites

The length of the Yuma cotton rat's head and body is usually 5-8 inches, with a long tail and hind feet. The long course body fur is especially pale in color with underparts that are silvery or grayish. (Hoffmeister 1986). They breed all year with a gestation period of 27 days and may have as many as 9 litters a year consisting of usually 5-6 young. They nest either on the surface or in a burrow (Burt and Grossenheider 1964). The young leave the nest in 4-7 days and are sexually mature in 40 days. Main diet consists primarily of green vegetation, but it may also eat the eggs of ground-nesting birds (Burt and Grossenheider 1964).

Near Morelos Dam (Yuma County, Arizona), they have been collected in stands of arrowweed (*Pluchea sp.*), cattails

(*Typha sp.*) and cane (*Phragmites sp.*) (Hoffeister 1986). Also near Yuma, they have been found in fields of bermuda grass, especially along the edges of the fields where the grass is taller and there is more brush (Hoffmeister 1986). In these fields, the hispid cotton rat makes surface runways along which may be found small piles of cut grass stems (Burt and Grossenheider 1964).

Distribution and Abundance

The Yuma hispid cotton rat is known only from the Colorado River in southern Yuma County (Cockrum 1960). They occur in the valley of the Colorado River from the vicinity of Yuma southward (Hoffmeister 1986). Most of the hispid cotton rats in the Yuma area are found near the Colorado River or along sloughs in brushy or weedy areas next to the river. Based on trap success rates, an estimate of 5,000 cotton rats inhabited bermuda grass fields in the vicinity of Yuma in 1958 (Hoffmeister 1986). At one time, the species may have inhabited the western part of the Gila River valley east of Yuma (Hoffmeister 1986).

Effect Analysis

Projected lower Colorado River operation and/or maintenance activities will have no effect on the Yuma hispid cotton rat.

l. Loggerhead Shrike (*Lanius ludovicianus*)

Description and Life Requisites

With a black face mask and appearing big-headed, the loggerhead shrike is slim-tailed, slightly smaller than a Robin; gray above, white below, it displays a small white patch on black wings during flight. A raptor that lacks talons and has weak feet, it has a strong, hooked bill for use in catching and feeding on rodents, lizards, small birds, and insects. To compensate for the lack of ability to hold prey firmly in its feet, the Shrike becomes, in effect, a tool user by impaling its food on thorns, barbed wire, or other sharp objects to immobilize the carcass while it eats (Ryser 1985).

Distribution and Effect Analysis

It prefers desert shrublands, juniper, or pinyon-juniper woodlands and is a fairly common breeder along the lower Colorado River. Breeding habitat adjacent to the river is open desert or washes characterized by sparse desert riparian vegetation (Rosenberg et al. 1991). It is a winter resident to the river area and is often observed near agricultural fields. The breeding range of the loggerhead shrike extends from California, eastern Oregon, and eastern Washington in the west, north to central Saskatchewan, east to Quebec, New York, and Pennsylvania, and south to Florida, the Gulf States, and Mexico (American Ornithologists' Union 1983). Loss of breeding habitat and possibly pesticides have been factors in the decline of the species in parts of its range (Ehrlich et al. 1988). Lower Colorado River valley loggerhead shrike populations are believed to be relatively stable (Rosenberg et al. 1991). River operations have no effect on the loggerhead Shrike populations.

m. Large-billed Savannah Sparrow (*Passerculus sandwichensis rostratus*)

Description and Life Requisites

A subspecies of savannah sparrow, the large-billed Savannah sparrow is a small sparrow, streaked above and below. The legs are of a pale pink coloration, and often there is a pale yellow streak visible over the eye, especially in summer. The tertials are long, to protect the wing from abrasion against grasses, and the tail is slender, short, and notched. The large-billed, a Mexican race, is paler than other savannah sparrows, without well-defined markings on the back and crown, and the breast streaks are diffuse.

Distribution and Abundance

A seed and insect eater, especially beetles, it is a rare post-breeding and winter visitor to coastal southern California, the Salton Sea, and the lower Colorado River where it is observed primarily in salt-cedar near the river mouths (Garrett and Dunn 1981). Its decline as a fall and winter visitor to the lower Colorado River may be due to habitat changes in the Colorado River delta (Unitt 1984).

Effect Analysis

It is anticipated that Colorado River operations will not effect significant change in riparian vegetation over the next 5 years. Consequently, no effect to this species is anticipated.

n. Arizona Toad (*Bufo microscaphus microscaphus*)

Description and Life Requisites

Bufo microscaphus (Southwestern toad) occurs along washes, streams, and arroyos and consists of two geographically separated subspecies (Stebbins 1966). *Bufo m. microscaphus*, the Arizona toad, occurs in scattered populations along tributaries of the Colorado River, whereas *Bufo m. californicus*, the arroyo toad, occurs in California along coastal drainages from San Luis Obispo County south into Baja California and in the Mohave Desert along the Mojave River, downstream as far as Victorville (Stebbins 1951). Stebbins theorized that the two subspecies arose when the Mohave River ceased to flow into the Colorado River during the late Pliocene or early Pleistocene. The systematics of *Bufo microscaphus* has been difficult to clarify, because the species frequently hybridizes with *B. woodhousei*, a common and widely distributed species.

Bufo microscaphus is a stocky toad, 2-3 inches in length, with a dorsal coloration that can vary between greenish-gray, buff, brown, and salmon. They can be distinguished from other toads by their oval-shaped and widely separated parotoid glands and by usually showing a light area on each side of the sacral hump and in the middle of the back (Stebbins 1966). A light-colored stripe extends along the top of the head but does not continue onto the body. The *microscaphus* subspecies can be morphologically separated from its *californicus* counterpart by having parallel rather than divergent paratoids, smoother skin, and reduced dorsal spotting (Stebbins 1951).

The species reproduces during March, April, and May, and eggs are deposited in long strings within gravel, mud, and detritus or atop clean sand at the bottom of pools (Stebbins 1951). Larvae have red-tipped tubercles on their back and yellow on the underside of their feet (Stebbins 1966). Adult *Bufo m. microscaphus* occurs in a variety of habitats; Stebbins (1951) has observed them in agricultural fields, along irrigation ditches, on damp soil near rivers, and in marshes comprised of sedges and bulrushes. Adults feed mainly on insects but also have been observed eating snails and plant material. Although toads differ from frogs in their tendency to walk rather than hop, *Bufo microscaphus* is a competent hopper and can travel 18 inches in a single leap (Stebbins 1951).

Distribution and Abundance

The species *Bufo microscaphus* (assumed to be *Bufo m. microscaphus*) was first described in 1867 from specimens collected during the 1857 Ives Expedition that explored the lower Colorado River from Yuma to the present site of Hoover Dam (Stebbins 1951). Later interpretation of the collected specimens placed the type locality at Fort Mohave, an Army outpost from the 1800s that was located on the Arizona side of the Colorado River northeast of the present location of Needles. However, Stebbins (1951) described *B. m. microscaphus* collected from "along the Colorado River to Willow Beach" as morphologically closer to *B. woodhousei* than *B. microscaphus*. Thus it is not entirely clear if the Arizona toad was ever an inhabitant of the mainstream lower Colorado River.

Outside of the mainstream lower Colorado River, the current distribution of *B. m. microscaphus* in Arizona was described by Stebbins (1951) as along the Hassayampa and Agua Fria Rivers, both tributaries of the Gila River, and along the Big Sandy and Bill Williams Rivers above their confluence. Stebbins described the subspecies in Nevada as being found near Las Vegas and along the Meadow Valley Wash, a drainage that empties into the Muddy River northwest of Overton. The *microscaphus* subspecies also has been found in Utah along the upper Virgin River as far north as Zion National Park and as far south as St. George. The most recent survey for Arizona toad in Arizona described the subspecies as occurring along the Virgin River near Littlefield, along the Hassayampa River, and along the drainages of the Bill Williams, Agua Fria, Verde, Little Colorado, Salt, and Gila Rivers (Sullivan 1993).

Effect Analysis

The lack of recent records suggests that the Arizona toad is currently absent along the lower Colorado River. This is the result of three possible scenarios: 1) the subspecies never occurred on the mainstream; 2) the subspecies has become extinct on the lower Colorado River independent of *B. woodhousei*; or 3) the subspecies was once present but has been displaced by *B. woodhousei* through hybridization. The last scenario has been hypothesized to have occurred on the Bill Williams River in the vicinity of Alamo Lake (Sullivan 1993). The closest location to the lower Colorado River that the subspecies is currently known to inhabit is at the Ramon Esquerra Ranch, 6 miles upstream of Lake Havasu along the Bill Williams River (J. Rorabaugh, FWS Phoenix, pers. comm.).

Therefore, the present known distribution of the Arizona toad indicates that the subspecies will not be affected by current Colorado River operations. Given the Arizona toad's confused systematics, however, it may be prudent to conduct a survey for the subspecies along the lower Colorado River if its status is elevated to threatened or endangered.

o. Desert tortoise (Sonoran population) (*Gopherus agassizii*)

See Mohave population above

p. Rosy Boa (*Lichanura trivirgata*)

Description and Life Requisites

A heavy bodied snake with a short blunt tail, the Rosy Boa has an average adult length of about 2 feet, although an occasional individual might reach a length up to 3.5 feet. Its scales are small and smooth, and those on top of the head are not enlarged (Cochran and Coleman 1970). It has no chin shields or large head plates, except on the snout. The dorsal pattern is slaty, beige, or rosy, marked with three longitudinal, broad reddish-brown stripes or irregular brown patches on a bluish, tan, or gray ground color (Stebbins 1966). A slow moving snake, often moving with its body stretched in a straight line, this extremely gentle reptile may roll up into a tight ball for protection when harassed (AGFD 1993).

It inhabits rocky brushlands and deserts and is attracted to oases or permanent or intermittent streams but does not require permanent water. Though chiefly nocturnal it may be active at dusk, feeding on small mammals and birds (Stebbins 1966). Unlike many snakes, it brings forth its young alive, rather than lay eggs (Cochran and Coleman 1970).

Distribution and Abundance

There are three subspecies: Coastal Rosy Boa (*L. t. roseofusca*), Desert Rosy Boa (*L. t. gracia*), and Mexican Rosy Boa (*L. t. trivirgata*). The Coastal Rosy Boa is found in southwestern California and adjacent lower California, while the Desert Rosy Boa inhabits southeastern California and southwestern Arizona, with isolated populations in Harcuvar, Harquahala, Castle Dome, and Kofa Mountains, Arizona. The Mexican Rosy Boa is found in southern Arizona (Organ Pipe Cactus National Monument) to Guaymas, Sonora, at the tip of Baja California (Stebbins 1966).

Effect Analysis

Only the Desert Rosy Boa has a distribution that may include areas of close proximity to the lower Colorado River. Although potential habitat may be found in adjacent areas, no populations have been observed where routine operation and/or maintenance activities occur. The project is not likely to effect the Rosy Boa.

q. Cowles's fringe-toed lizard (*Uma notata rufopunctata*)

Description and Life Requisites

Populations of the Colorado Desert fringe-toed lizard, *Uma notata* are separated by the lower Colorado River into two subspecies: *U. n. notata* occurs in southeast California and *U. n. rufopunctata* occurs in southwest Arizona. Lizards in the genus *Uma* are adapted to sand dune habitats by possessing a fringe of scales on their toes and well-developed ear flaps to permit burying into loose sand (Stebbins 1966). Adults measure 2.75 to 4.5 inches from the tip of the snout to the vent at the base of the tail. Their dorsal coloration is a mottled brown with black flecks, and their white ventrum is marked with black bars on the tail, diagonal lines on the throat, and a black spot on each side of the belly. The two subspecies can be differentiated by the black belly-spots being outlined by orange in *U. n. notata* but not in *U. n. rufopunctata*. These diurnal lizards are capable of fast, bipedal running and feed primarily on insects.

Distribution and Abundance

Cowles's fringe-toed lizard is entirely restricted to wind-blown sand dunes in Yuma County, Arizona, and northwestern Sonora, Mexico. Locality records include Yuma Dunes, 8.6 miles south of Vincent Field, and Wellton Mesa (Vitt and Ohmart 1978).

Effect Analysis

Cowles's fringe-toed lizard will not be affected by current operations on the lower Colorado River due to the species's habitat being restricted to windblown sand. The only location where the subspecies may occur near potential Reclamation activities would be within the Limitrophe Division along the Arizona side of the river south of Yuma. This area will be surveyed for *U. n. rufopunctata* prior to any Reclamation activity if the subspecies is elevated to threatened or endangered status.

r. Chuckwalla (*Sauromalus obesus*)

Description and Life Requisites

Chuckwallas vary in color with age, sex, locality, conditions of heat, and state of activity. The young are banded, especially on the tail. Adults usually have the head and fore part of the body darker, the tail lighter. Males frequently show a reddish wash. In the morning when the sun comes out, they emerge from their hiding places in rocky crevices and bask until warm enough to begin foraging on fruits, flowers, buds, and leaves of desert plants. Vitt and Ohmart (1978) describe chuckwallas as being exclusively vegetarian, feeding on leaves and flowers of creosote bush, flowers of palo verde and cacti, and other plants. They may be quite abundant in places but difficult to collect. When alarmed, they take refuge in rock crevices or underneath rocks. Females lay six to ten white soft-shelled eggs during the summer months (Cochran and Coleman 1970).

Distribution and Abundance

The western chuckwalla (*Sauromalus obesus obesus*) is a rock dwelling herbivorous lizard widely distributed in the deserts of southeastern California, western Arizona, southern Nevada, and extreme southwestern Utah (Cochran and Coleman 1970). These lizards are restricted to areas with large rocks and boulders, usually on barren hills and mountains below 4000 feet. They also occur in ancient lava beds (Smith 1946). The creosote bush, a staple food, occurs throughout its range. Rocks provide shelter and basking sites (Stebbins 1966).

They can be expected to occur along the lower Colorado River, including proposed quarry sites (see Figure C-1), wherever lava flows, rocky hillsides, talus slopes, and/or rocky outcrops exist. Vitt and Ohmart (1978) reported collecting numerous specimens (chuckwallas) in rocky areas on both sides of the Colorado River from Davis Dam south to the international border near Yuma, Arizona.

Effect Analysis

Activities associated with river and/or quarry operations are not likely to significantly affect the overall chuckwalla population occurring along the lower Colorado River. Very little suitable habitat for chuckwallas occurs within close proximity to the river channel. In areas where suitable habitat does occur in close proximity to the river channel, such as canyon areas, changes in river flows are not of such rate or magnitude to adversely effect established individuals. Generally, activities associated with existing quarries do take place within known chuckwalla habitat and such activities have probably resulted in the loss or displacement of some individuals. Site specific effect analyses of the quarries will be completed prior to future use.

s. Grand Wash Springsnail or Grapevine Springsnail (*Pyrgulopsis bacchus*)

Description and Life Requisites

Pyrgulopsis bacchus is a small, freshwater snail that inhabits springs and has a brownish, oval shell .0625 to.25 inches in diameter. The snail tends to occur on rocky substrates and appears to prefer clear, flowing water near the inlet of the spring (Ross Haley, LMNRA pers. comm.). This behavior suggests that *P. bacchus* feeds on periphyton, a diet associated with freshwater snails found in fast-current areas (Harman 1972, cited in Thorp and Covich 1991). The species was only recently described (Hershler and Landye 1988), and virtually nothing is known of its biology.

Distribution and Abundance

P. bacchus is known only to occur in Tassi Spring along Pigeon Wash and in Grapevine Spring, where the species was first described, and Whiskey Spring along Grand Wash (Hershler and Landye 1988; and Jerry Landye, FWS, Pinetop, Arizona, pers. comm.). Both washes flow southward into the upper end of Lake Mead in extreme northwest Arizona. Grapevine and Whiskey Springs are located on BLM-administered lands and Tassi Spring is within Lake Mead National Recreation Area, managed by the NPS.

Effect Analysis

Of the three springs that the snail inhabits, Tassi Spring is the closest to Lake Mead. The maximum elevation of Lake Mead is 1,229 feet. Tassi Spring is located at an elevation of 1,540 feet (from Gyp Hills 7.5' USGS topo), 311 feet higher. Therefore, fluctuations in surface-water elevation at Lake Mead will not affect Tassi Spring or its inhabitants.

t. White Desertsnail (*Eremarionta immaculata*)

Description and Life Requisites

The white desertsnail is a small terrestrial snail (approximately one-half inch in diameter) found in rock slides at the bottom of desert mountain ravines (W. Miller, Santa Barbara Museum of Natural History, pers. comm.). Although other members of the genus sport a brown stripe around the periphery of their shells, the white desertsnail shell lacks this stripe and instead is entirely white (Pilsbry 1939). The snails are dormant throughout most of the year, burying themselves within talus and sealing their shell-openings to rocks to conserve water (Pilsbry 1939). They become active (so to speak) after winter rains and feed on detritus and fungi (W. Miller, pers. comm.). White desertsnails have a lifespan of 8 to 12 years.

Distribution and Abundance

White desertsnail was first collected in 1937 on the east slope of the Riverside Mountains adjacent to the lower Colorado River, 7 miles south of Vidal in San Bernardino County, California (Pilsbry 1939). The species again was collected in the same general area in 1947 and 1958 (Lindsey Groves, Los Angeles County Natural History Museum pers. comm.). Although a systematic survey for this species has not been conducted, the snail more recently has only been found 27 miles south of the type locality in the McCoy Mountains northwest of Blythe, California (W. Miller pers. comm.). White desertsnails do not occur in Arizona.

The extant species of *Eremarionta* are relict populations once widespread during the colder climate of the Pleistocene but now isolated on various desert hills and mountains. Pilsbry (1939) described the species within the group as "feebly characterized local races." The genus includes nine species in the United States; all are restricted to southeast California except for one species that extends into extreme western Arizona (Bequart and Miller 1973). *Eremarionta* extends from Temple Bar, Arizona, south along the eastern edge of the Colorado River into Baja California and west to Indio, California (W. Miller, pers. comm.).

Effect Analysis

Being a dweller of the desert, white desertsnails can only be potentially affected by the operation of the quarry sites. The occurrence of white desertsnails in rock slides at the base of ravines also suggests the potential for quarries to affect this species. Empty shells remaining from deceased snails should make this species easy to detect. Although quarries currently are not operated or planned at the McCoy Mountains, one quarry has operated in the Riverside Mountains immediately north of the type locality. This quarry, the Agnes Wilson Quarry, currently is inactive. Surveys funded by Reclamation for white desertsnail and other sensitive species are being conducted at the Agnes Wilson Quarry and other potential quarry sites to ensure that these species will not be affected by quarry activation.

u. Cheeseweed owlfly (aka moth lacewing, mothlike netwing, ithonid lacewing) (*Oliarces clara*)

Description and Life Requisites

Oliarces clara belongs to the family Ithonidae within the insect order Neuroptera. Worldwide the Neuroptera includes 4,760 species including lacewings, antlions, snakeflies, and fishflies (Arnett 1993). Seven species of Ithonidae have been described, and all of them occur in Australia except for one - *O. clara*, a native of the American Southwest. Adult moth lacewings are approximately .75 to 1.33 inches in length and resemble oversized, winged termites or ants. When alive, the insect's abdomens are a bright turquoise (Jeff Knight, Nevada Division of Agriculture, Reno, pers. comm.).

Like other Neuroptera, *O. clara* undergoes complete metamorphosis. In captivity, the adult females lay their eggs on the soil (Faulkner 1990). After the eggs hatch, the larvae are believed to burrow into the soil and attach to plant roots. Larvae have only been found in the wild associated with the roots of creosote bush (*Larrea tridentata*). The Ithonidae are the only species of Neuroptera in the world that are thought to feed on plants, as all other species are predaceous.

Most is known of *O. clara*'s adult behavior. Adults emerge from the soil in large aggregations typically during mid-April to mid-May (Faulkner 1990). The adults are weak fliers and have been observed walking more than flying. On the first day of emergence, the males aggregate early in the morning on the tallest nearby object - at one site a telephone pole. The activity ceases by noon with the insects taking shelter under rocks or vegetation. Adults re-emerge and mate during the second day. Less activity occurs on the third day, and by the fourth day the insects are either dispersed or dead.

Although the timing of adult emergence during the spring is consistent, the years during which emergence occurs, even at the same site, is not consistent. Emergence appears to follow winters with high precipitation.

Moth lacewings are preyed upon during their adult swarms. Birds observed feeding on the insects include rock wrens, barn swallows, and black-throated sparrows (Faulkner 1990). Robber flies (*Diptera: Asilidae*) and black widow spiders also have been observed as predators.

Distribution and Abundance

O. clara appears to be sporadically distributed across the deserts of southeast California, southwest Arizona, and southern Nevada (Table 14). The insect was first collected in 1908 at Walter's Station (now gone but presumed to be near Mecca), California, near the Salton Sea (Belkin 1954). The species was not collected again until 1949, when a single adult was attracted to a light near Parker (presumed to be Earp), California.

The spotty distribution of this species contradicts the hypothesis that the insect is associated with creosote bush, an ubiquitous shrub of the desert Southwest. However, it is likely that *O. clara* is more widely distributed than the collection records would suggest and most emergence sites go undetected due to the insect's infrequent and short-lived appearances as an adult (D. Faulkner pers. comm.).

Effect Analysis

Being an inhabitant of the desert, *O. clara* can only be potentially affected from operation of the lower Colorado River by mining at the quarry sites. The only recorded observation of

Table 14. Collection records of the moth lacewing, *Oliarces clara*.

Location	Date	Reference
Walter's Station (near Mecca) Riverside County CA	April 1908	Belkin, 1954
Parker (Earp) San Bernardino County CA	May 29, 1949	Belkin, 1954
Gila Mountains (15 mi E of Yuma) Yuma County AZ	April 23, 1949	Belkin, 1954
near Palm Springs Riverside County CA	1964	Faulkner 1990
Painted Canyon (near Mecca) Riverside County CA	April 15, 1974	U.C. Riverside Entomology Museum
Deep Canyon (near Palm Springs) Riverside County CA	April 15, 1974	U.C. Riverside Entomology Museum
Black Mountain (NE of Glamis) Imperial County CA	April 15 - May 15, 1979	Faulkner 1990
Black Mountain (NE of Glamis) Imperial County CA	April 15 - May 15, 1982	Faulkner 1990
Telegraph Pass Yuma County AZ	April 11, 1983	U.C. Riverside Entomology Museum
Boulder City Clark County NV	May 11, 1992	Jeff Knight NV Div. Agriculture
Road between Rice and Blythe Riverside County CA	not given	Faulkner 1990

O. clara near the lower Colorado River was the single adult attracted in 1949 to a light at Parker (presumed to Earp), California. A nearby emergence site has never been located. The closest quarry near Earp is the Vidal Junction Quarry, 10 miles to the west. The Vidal Junction Quarry has been closed for years and likely will not be reopened in the future. Therefore, the information available indicates that *O. clara* will not be affected from river operations. Given that the insect's distribution has not been fully described, a more thorough survey for *O. clara* at the quarries may be warranted if its status is elevated to threatened or endangered.

v. MacNeill's sootywing (*Hesperopsis gracielae*)

Description and Life Requisites

The insect order Lepidoptera includes the moths and butterflies. The skippers, or Hesperiidae, are related to the butterflies but differ by typically having antennae that are hooked at the tip. The genus *Pholisora*, or the sootywings, contains five species distributed throughout the United States; they have a wingspan of 22-30 mm, and their wings are very dark with rows of white spots near the outer margin (Arnett 1993). MacNeill's sootywing was first considered within *P. alpheus* (Comstock 1927) but split-off in 1970 as the separate species, *P. graciliae*, based on morphological characters (MacNeill 1970).

Members of the Lepidoptera undergo complete metamorphosis, meaning that their life-cycle includes the stages of egg, larva, pupa, and adult. The larvae of most Lepidoptera are phytophagous; members of the genus *Pholisora* feed on plants in the families Chenopodiaceae and Amaranthaceae (Arnett 1993), and *P. graciliae* feeds only on quailbush, *Atriplex lentiformis* (Chenopodiaceae) (Emmel and Emmel 1973). Larvae of *P. graciliae* are dull green, covered with whitish nodules that support short hairs and enclose themselves within a rolled-up leaf when not feeding (Emmel and Emmel 1973). Two generations occur yearly with adult flights in April and in July to October. Emmel and Emmel (1973) describe the adult flight of *P. graciliae* as weak and fluttering. Female Lepidoptera typically deposit their eggs on the larval food source.

Distribution and Abundance

P. gracielae occurs along the lower Colorado River from Yuma, Arizona, north into southern Nevada, in southern Utah, and in the Coachella Valley (*Hesperopsis alpheus* ssp. *gracielae,* Scott 1986) and Imperial County (MacNeill 1970) in southeastern California. The species was described from specimens first collected in Bennett Wash, California, 8 miles south of Parker Dam (MacNeill 1970). Large populations of *P. gracielae* occasionally have been observed at Cibola National Wildlife Refuge near Blythe, California, and along the lower Bill Williams River east of Lake Havasu (Mark Nelson, USBR, Denver, pers. comm.). The insect also has been found in Cochise County in southeastern Arizona (Table 15).

Being a specialist on quailbush, the insect's distribution would be dependent upon, and therefore likely reflect, that of its plant host. Munz (1974) describes the distribution of *A. lentiformis* in southern California as "Alkaline places, mostly below 2000 ft.; Alkali Sink; Mohave and Colo. deserts to Utah, Son., L. Calif." In Arizona, *A. lentiformis* is found in "Coconino and Mohave Counties, south to Pima and Yuma counties, 4,000 feet or (usually) lower, in moist or dry, saline soil, type from along the Colorado River... Southern Utah and Nevada to Sonora and California", (Kearney and Peebles, 1951).

Table 15. Collection records of MacNeill's sootywing, *Pholisora graciliae*.

Location	Date	Reference
Blythe Riverside County CA	July 30, 1929	U.C. Riverside Entomology Museum
Neighbours, Colorado Desert	April 28, 1930	U.C. Riverside Entomology Museum
near Calexico Imperial County CA	April 5, 1932	Emmel and Emmel, 1973
near Calexico Imperial County CA	May 5, 1934	Emmel and Emmel, 1973
Mouth of Dead Indian Canyon (Palm Desert, Riverside County CA)	May 7, 1936	U.C. Riverside Entomology Museum
3 miles N of Blythe Riverside County CA	May 24, 1972	U.C. Riverside Entomology Museum
San Simone Agricultural Area Cochise County AZ	July 14, 1986	U.C. Riverside Entomology Museum
Earp San Bernardino County CA	May 28, 1989	U.C. Riverside Entomology Museum

Effect Analysis

Population levels of MacNeill's sootywing will be primarily affected by changes in the areal extent of *A. lentiformis*, its native host plant. Although most native trees and shrubs on the lower Colorado River floodplain have been decimated by the invasion of saltcedar (*Tamarix ramossissima*), *A. lentiformis* has not been as severely affected. In fact, the trend in quailbush's abundance appears to be the opposite; the areal extent of quailbush along the lower Colorado River increased from 597 to 1,231 acres between 1981 and 1986 (Younker and Andersen 1986). Compared to other native, riparian plants along the lower Colorado River, quailbush is more tolerant of saline soils and lowered groundwater elevations (Pinkney 1992). These traits may make *A. lentiformis* less susceptible to displacement by saltcedar.

Based on the increasing abundance of quailbush reported, current operation of the lower Colorado River will not affect populations of *P. graciliae*. Vegetation maps for the lower Colorado River should continue to be updated to verify that quailbush's areal extent does not decline.

w. Dune sunflower, silver-leafed sunflower - (*Helianthus niveus ssp. tephrodes*)

Description and Life Requisites

Members of the genus *Helianthus* are commonly known as the sunflowers. Munz (1974) describes *Helianthus niveus* ssp. *tephrodes* as an erect or decumbent (lying down with tip erect) perennial or annual, 20 to 60 inches tall, supporting several flower heads. Each flower head is composed of reddish disk flowers growing at its center surrounded by a ring of yellow ray flowers. The species flowers biannually during March to May and October to January. The dune sunflower may best be distinguished by white, silky hairs that grow on its stems and leaves.

Distribution and Abundance

Dune sunflower grows in sandy desert areas adjacent to creosote bush scrub between the southeast corner of California and the Imperial Valley (Munz 1974). Although the plant's range extends south into Sonora, Mexico, it does not occur in Arizona. Edmund Jaeger, the renowned California desert botanist and naturalist, described *H. niveus* (silver-leafed sunflower) as a "rare plant of the Algodones sand dunes of the Colorado Desert" (Jaeger 1940). The similar taxonomy, descriptions, and distributions suggest that Jaeger's *H. niveus* and the *H. niveus* ssp. *tephrodes* described by Munz are synonymous.

Effect Analysis

Dune sunflower will not be affected by current and future operations on the lower Colorado River due to the plant's distribution being confined to the Algodones Dunes southeast of the Salton Sea. Operation and maintenance of the lower Colorado River mainstream does not affect this area, and quarry sites for river armoring do not exist within the Algodones Dunes.

x. Sand food (aka sand sponge, sand root, or biatatk [Tohono O'odham word meaning "sand root," Jaeger 1940]) (*Pholisma sonorae*)

Description and Life Requisites

Ammobroma sonorae is a parasitic plant evident only by a flat and round, sand-colored inflorescence (1 to 4 inches in diameter) that is densely covered with minute, purple flowers (Munz 1974). *Ammobroma* flowers in April and May. Jaeger (1940) stated that *Ammobroma*'s inflorescences "lie flat like big buttons on the sand and are easily overlooked by the average observer." Beneath the inflorescence, a single, long (39-inch) stem lies hidden in the sand that reaches downward to the roots of its plant host, the source of *Ammobroma*'s nutrients (Munz 1974). Host plants include *Coldenia palmeri* and *C. plicata* (Boraginaceae) and *Eriogonum deserticola* (Polygonaceae); a single host root typically supports four to eight *Ammobroma* (Jaeger 1940). The common name "sand food" may derive from *Ammobroma*'s use as a food source by Native Americans. *Ammobroma* stems were eaten raw or cooked, and when roasted produces a flavor similar to yams (Jaeger 1940).

Distribution and Abundance

Munz (1974) described *Ammobroma* as occurring on sand hills below 1,000 feet in the Colorado Desert east of the Imperial Valley. Jaeger (1940) describes a similar distribution, with the plant being "plentiful on the Algodones sand hills west of Yuma and at the head of the Gulf of California." In Arizona, *Ammobroma* occurs in the same habitat in southern Yuma County along the Mexican boundary (Kearney and Peebles 1951).

Effect Analysis

Ammobroma sonorae will not be affected by current operations on the lower Colorado River due to the plant's habitat being restricted to windblown sand. The only location where the subspecies may occur near potential Reclamation activities would be within the Limitrophe Division along the Arizona side of the river south of Yuma. Sites of suitable habitat for *P. sonorae* will be surveyed for this plant prior to any Reclamation activity in the area.

y. Foxtail cactus (*Coryphantha vivipara* var. *alversonii*)

Description and Life Requisites

Foxtail cactus grows as a cluster of one or a few cylindrical bodies (stems) that branch from a common base and reach a height of 4 to 8 inches (Munz 1974). The cactus is best identified by its 0.5- to 1-inch long spines that are white at the base but dark (black, purple, or red) at the tip, thus giving it a frosted appearance that supposedly resembles a fox's tail. Light-purple to magenta flowers (1-inch long) are produced in May and June that develop into edible fruit. The plant'sscientific name is after Andrew Alverson (1845-1916), a cactus dealer in San Bernardino, California, who first collected the cactus near Twenty-Nine Palms (Jaeger 1940).

Distribution and Abundance

Foxtail cactus is found on rocky slopes between 2,000- and 5,000-foot elevation from the Little San Bernardino Mountains (western end of Joshua Tree National Monument) southeast to the Eagle and Chuckwalla Mountains (Munz 1974). Benson (1982), however, describes a wider distribution in California with the cactus occurring along the transition between the Mohave and Colorado Deserts in southern San Bernardino County, Riverside County, and southeast Imperial County. We have observed foxtail cactus on the eastern slope of the Riverside Mountains in Riverside County; this locality is north of the range described by Munz but within that described by Benson. Thus it appears that the wider distribution offered by Benson is more accurate. In Arizona, the only record of foxtail cactus is at Pagumpa (a ghost town) in Mohave County (Benson 1982). Foxtail cactus is not listed in Kearney and Peebles (1951).

It should be noted that a similar variety, *C. v.* var. *desertii* (*Mamillaria desertii*), occurs in eastern San Bernardino County, California, and in northern Mohave County, Arizona (Benson 1982). *C. v.* var. *desertii* is not a species of concern. Munz (1974) characterizes *C. v.* var. *desertii* as also having bicolor spines similar to *C. v.* var. *alversonii*. In California, Munz describes *C. v.* var. *desertii* as being restricted to the Mohave Desert and occurring in the Ivanpah and Clark Mountains in northeast San Bernardino County near Interstate-15; these mountains are further from the Riverside Mountains, where we have found foxtail cactus, than are the Chuckwalla Mountains. In any case, future surveys for foxtail cactus will likely need to differentiate the two varieties. The best character for doing so appears to be the number of central spines. The spines of cacti radiate out from points on the cactus's surface called areoles. Central spines radiate from the center of the areole and tend to project outward from the plant surface rather than lie flat. In *C. vivipara*, it is the central spines that are bicolored. *C. v.* var. *alversonii* has 12 to 16 central spines at each areole, whereas *C. v. var. desertii* has 4-6 (Munz 1974).

Effect Analysis

River operations conducted by Reclamation will not affect foxtail cactus. However, foxtail cactus may be affected by the operation of quarry sites that mine armoring for the lower Colorado River. Our observation of foxtail cactus in the Riverside Mountains resulted from a desert tortoise survey we conducted at the Agnes Wilson quarry site, an inactive quarry west of the Agnes Wilson Bridge. The cactus was abundant immediately north of the quarry's access road. To help ensure that the species is not negatively affected, formal surveys for foxtail cactus will be conducted at each active quarry and prior to the reactivation of any proposed quarries.

z. Crissal Thrasher (*Toxostoma crissale coloradense*)

Description and Life Requisites

This thrasher is large (11.5 inches) and slender, with a distinctive chestnut undertail patch and a dark whisker streak.

This species is present in most riparian woodlands, favoring those areas with sandy soils. Honey mesquite habitats support the largest populations throughout the year, and the bird is rarely found far away from dense cover (Rosenberg et al. 1991). Nesting is usually in mesquite trees, but saltcedar and quail-bush may also be utilized.

Distribution and Effect Analysis

The lower Colorado River lies along the western edge of the crissal thrasher's range. This subspecies also occurs along the Bill Williams River, Big Sandy River, and possibly the lower Gila River, the Little Colorado River, and in the Grand Canyon (Rosenberg et al. 1991).

Although the crissal thrasher is listed as a Species of Special Concern by the CFG, Rosenberg et al. (1991) did not detect a serious population decline in the lower Colorado River valley. Since no significant change is anticipated in the riparian community over the next 5 years, it is anticipated that Colorado River operation and maintenance activities will not affect this species.

C. Marsh

1. Endangered

a. Brown Pelican (*Pelecanus occidentalis*)

Description and Life Requisites

Easily recognized by its large pouch, a fully grown brown pelican can have a wingspan of 7 feet. Although they usually inhabit coastal waters, the birds sometimes forage as far as 100 miles offshore. In California, brown pelicans feed mainly on northern anchovy, Pacific sardine, and Pacific mackerel (Thelander and Crabtree 1994).

Brown pelicans were added to the Federal endangered species list in 1970. In the late 1960s, biologists discovered that pesticide-caused eggshell thinning had decimated brown pelican populations including those in southern California. Populations have rebounded since the banning of DDT, and the question of whether to reclassify the pelican is currently a contested issue.

Distribution and Abundance

The majority of California's brown pelicans nest south of the border, mostly on islands along the Pacific coast of Baja California, Mexico, and in the Gulf (between 50,000 and 75,000 pairs) (Thelander and Crabtree 1994).

Along the lower Colorado River, the brown pelican is a rare but annual post-breeding wanderer from Mexico in late summer and early fall. It is most frequently seen around Imperial Dam, but individuals have occurred north to Davis Dam and even to Lake Mead. Virtually all records are of lone immature birds, undoubtedly dispersing from breeding colonies in the Gulf or perhaps via the Salton Sea (Rosenberg et al 1991). Along the river, they prefer large open-water areas near dams.

Effect Analysis

This species will not be affected as projected routine water operations over the next 5 years will not change the character of aquatic habitat potentially utilized by this species. Any change in the status of this species (e.g., breeding) would initiate a reexamination of potential operational effects.

b. Yuma Clapper Rail (*Rallus longirostris yumanensis*)

Description and Life Requisites

The Yuma clapper rail is a chicken-shaped marsh bird with a long, down-curved beak. Both sexes are slate brown above, with light cinnamon underparts and barred flanks. This subspecies is slightly lighter in color and slightly thinner than other clapper rails. Fully grown, the bird measures 14 to 16 inches long.

Yuma clapper rails are found in emergent wetland vegetation such as dense or moderately dense stands of cattails (*Typha latifolia* and *T. domingensis*) and bulrush (*Scirpus californicus*) (Eddleman 1989; Todd 1986). They can also occur, in lesser numbers, in sparse cattail-bulrush stands or in dense reed (*Phragmites australis*) stands (Rosenberg et al. 1991). The most productive clapper rail areas consist of a mosaic of uneven-aged marsh vegetation interspersed with open water of variable depths (Conway et al. 1993). Annual fluctuation in water depth and residual marsh vegetation are important factors in determining habitat use by Yuma clapper rails (Eddleman 1989).

Yuma clapper rails may begin exhibiting courtship and pairing behavior as early as February. Nest building and incubation can begin by mid-March, with the majority of nests being initiated between late April and late May. The rails build their nests on dry hummocks, on or under dead emergent vegetation and at the bases of cattail or bulrush. Sometimes they weave nests in the forks of small shrubs that lie just above moist soil or above water that is up to about 2 feet deep. The incubation period is approximately 28 days so the majority of clapper rail chicks should be fledged by August (Eddleman 1989). Yuma clapper rails nest in a variety of different micro habitats within the emergent wetland vegetation type, with the only common denominator being a stable substrate. Nests can be found in shallow water near shore or in the interior of marshes over deep water (Eddleman 1989). Nests usually do not have a canopy overhead as surrounding marsh vegetation provides protective cover.

Crayfish (*Procambarus clarki*) are the preferred prey of Yuma clapper rails. Crayfish comprise as much as 95 percent of the diet of some Yuma clapper rail populations (Ohmart and Tomlinson 1977). Availability of crayfish may be a limiting factor in clapper rail populations and is believed to be a factor in the migratory habits of the rail (Rosenberg et al. 1991). Eddleman (1989), however, has found that crayfish populations in some areas remain high enough to support clapper rails all year and that seasonal movement of clapper rails can not be correlated to crayfish availability.

One issue of concern with the Yuma clapper rail is selenium. Eddleman (1989) reported selenium levels in Yuma clapper rails and eggs and in crayfish used as food were well within levels that will cause reproductive effects in mallards. Rusk (1991) reported selenium levels in Yuma clapper rail tissues were within the range that causes hatching defects in many other birds, but the implications for rail biology were unknown.

Yuma clapper rail may be impacted by man-caused disturbance in their preferred habitat. In recent years the use of boats and personal watercraft has increased along the lower Colorado River. This has led to speculation that the disturbance caused by water activities such as those may have a negative impact on species of marsh dwelling birds.

Distribution and Abundance

This subspecies is found along the Colorado River from Needles, California, to the Gulf, at the Salton Sea and other localities in the Imperial Valley, California, along the Gila River from Yuma to at least Tacna, Arizona, and several areas in central Arizona, including Picacho Reservoir (Todd 1986; Rosenberg et al. 1991). In 1985, Anderson and Ohmart (1985) estimated a population size of 750 birds along the Colorado River north of the International Boundary. FWS (1983) estimated a total of 1,700 to 2,000 individuals throughout the range of the subspecies. Based on call count surveys, the population of Yuma clapper rail in the United States appears to be holding steady (Ron McKinstry, FWS, pers. comm.). This technique detects from 22 to 100 percent of the birds present, so these estimates must be considered minimum estimates (Eddleman 1989; Todd 1986). Yuma clapper rail is currently expanding its range (Ohmart and Smith 1973; Monson and Phillips 1981; Rosenberg et al. 1991), so there is a strong possibility that population size may increase. Yuma clapper rail appear to expand into desired habitat when it becomes available. This is evidenced by the colonization of the CFG Finne-Ramer habitat management unit in Southern California. This unit was modified to provide marsh habitat specifically for Yuma clapper rail. At the present time a substantial resident population exists there.

A substantial population of Yuma clapper rail exists in the delta area of the Colorado River in Mexico. Eddleman (1989) estimated a total of 450 to 970 Yuma clapper rails were present in the delta area in 1987. These were located in the Cienega, Sonora, Mexico (200-400 birds), along a dike road on the delta proper (35-140 birds), and at the confluence of the Rio Hardy and Colorado River (200-400 birds). Based on this census and Todd (1986), it is believed approximately one-quarter to one-half of the total population of Yuma clapper rail reside in Mexico.

Crayfish were introduced into the lower Colorado River about 1934. This food source and the development of marsh areas resulting from river control such as dams and river management helped to extend the breeding range of the Yuma clapper rail. The original range of the Yuma clapper rail was primarily the Colorado River delta. The first sighting of the Yuma clapper rail in the Bill Williams delta occurred 16 years after the completion of Parker Dam (Ohmart and Smith 1973). The northernmost confirmed record of occurrence was at Laughlin Bay, south of Laughlin, Nevada. There was an unconfirmed report of Yuma clapper rail calls at the lower end of the Grand Canyon in 1994 (Ron McKinstry, FWS, pers. comm.). The southernmost confirmed occurrence of Yuma clapper rail in Mexico was three birds collected at Mazaltan, Sinaloa; Estero Mescales, Nayarit; and inland at Laguna San Felipe, Puebla (Banks and Tomlinson 1974).

Yuma clapper rail were thought to be a migratory species, the majority of them migrating south into Mexico during the winter, with only a small population resident in the United States during the winter. Eddleman (1989) concluded the Yuma clapper rail was not as migratory as once thought and estimated approximately 70 percent remained in or near their home range during the winter.

A Recovery Plan was implemented in 1983 for the Yuma clapper rail. The criteria for downlisting of the species states there must be a stable breeding population of 700-1000 individuals for a period of 10 years. Other goals to be met include:

- Clarifying the breeding and wintering status in Mexico.

- Obtaining an agreement with Mexico for management and preservation of the species.

- Development of management plans for Federal and State controlled areas where the rails are known to breed.

- Written agreements are made with Federal and State agencies to protect sufficient wintering and breeding habitat to support the proposed population numbers.

As of 1994, not all of the above recovery actions had been met, and FWS recommended the Yuma clapper rail remain classified as endangered.

Effect Analysis

The Yuma clapper rail is a marsh dependent species. Therefore, discussions of the effect of current lower Colorado River operations on the Yuma clapper rail are discussions of marsh formation and succession along the lower Colorado River.

As stated in the discussion on marsh habitat on the river, marshes along the lower Colorado River are of two kinds. The first kind includes backwater marshes, which are defined as marsh areas adjacent to the river and are either directly connected to the river or are connected by seepage. The second kind, which is more extensive, includes those marshes formed by impoundments such as the marshes in Mittry Lake, Imperial Reservoir, Lake Havasu, and other similar impounded areas.

Portions of that discussion are repeated here for ease of the reader to understand the effects analysis.

Historically, backwater marshes on the lower Colorado River were neither extensive or numerous. Grinnell (1914) quoted in Ohmart et al. 1975, stated:

"The river's habit of overflow would be expected to result in rather extensive tracts of palustrine flora. As a matter of fact, however, marshes were few and of small size. This was probably due to the rapid rate of evaporation of overflow water so that favoring conditions did not last long, and also to the rapid silting-in of such water basins as ox-bow cutoffs. As a result there were either almost lifeless alkali depressions, or lagoons practically identical in biotic features with the main river. But in a few places there were well-defined palustrine tracts kept wet throughout the year, chiefly by seepage. These were always located back from the river near the outer edges of the broader valleys, where they were least affected during flood time. They were marked by growths of tules, sedge, and saltgrass, sometimes the latter alone, and were usually surrounded by arrowweed or willow association."

The construction of river control features, such as training structures, along the lower Colorado River, has resulted in the formation of more permanent and expansive backwater marshes. In 1986 over 400 backwater marshes were cataloged along the lower Colorado River from Davis Dam to Laguna Dam (Holden et al. 1986). Some of these marshes were created and are maintained specifically for mitigation for channel improvement projects. Reclamation actively pursues maintenance and restoration of backwater marshes not tied to mitigation on a cost shared basis. These backwater marsh habitats are subject to successional factors as were the historic marshes along the river. Under normal operating conditions, this succession is greatly slowed because current river conditions and operating criteria result in less scouring and associated sediment movement. Bankline stabilization has reduced erosion and associated sediment accrual to the river. When exceptional conditions are encountered, such as the high flow releases which occurred in 1983-1985, channel scouring occurs with associated sediment deposition in those backwater areas. These exceptional conditions would be expected to promote accelerated succession to upland conditions which are dominated by saltcedar (*Tamarix* sp.).

The majority of the banklines of the flowing river have been stabilized. This does not allow for natural marsh formation resulting from the river channel moving laterally, which would occur during high flows. Additionally, current river operating criteria reduce the opportunity for high (flood) flows which would also reduce natural marsh formation during those type of flows. A portion of the backwater marshes which exist along the river today are isolated from the main river channel. This reduces the opportunity for flushing flows through them. However, it was observed during the high flows experienced on the river during 1983 through 1985 that the isolated backwater marshes did not fill in with deposited sediment. Impacts which occurred to those isolated backwater marshes were a result of the main river channel scouring and the resulting drop in water table. In any case, the marsh communities that formed as a result of the impoundments and training structures are much greater in extent and permanence than those which occurred historically. As stated above, some of these marshes are specifically maintained for fish and wildlife purposes.

Presently there are slightly over 4,200 acres of marsh type 1 (cattail/bulrush) along the lower Colorado River in the United States (Carlson and Salas, pers. comm. 1996). An additional 10,600+ acres of this habitat exists in Mexico in the Cienega and other areas in the Colorado River delta. This type of habitat is preferred by rails. However, under certain conditions other types of marsh habitat may be used by rails (Eddleman 1989).

Direct Effects - Direct effects of discretionary routine, ongoing operations on the lower Colorado River fall into the following categories - effects due to fluctuating water levels, effects due to operating the YDP, and effects due to routine maintenance of river control structures such as banklines, jetties, and training structures. Included with routine maintenance is operation of the Laguna Dredge Basin and dredging at the headworks of the All-American and Gila Gravity Main Canals immediately above Imperial Dam.

The major problems with flow variation and effects to rails are probably related to the speed with which **rises** in water level occur and the timing of the rises (Eddleman 1989). If abrupt rises occur during nesting, nests may be lost (Smith 1975). More gradual rises probably allow birds to adapt nests in some cases. Sudden drops in water level expose additional habitat on riverine marshes and may provide additional nesting/foraging sites if timed early in the breeding season (Eddleman 1989). However, drops in water level could expose nests to terrestrial predators.

Effects to marsh formation could stem from the daily and seasonal water fluctuations in certain areas of the river. Marsh formation tends to occur where the water levels are relatively stable, and the banklines are gently sloping. An indirect effect to marsh formation may occur in areas of the river where the daily fluctuations tend to prevent establishment of marsh type vegetation. Again, the marsh formation is probably more a function of channel and floodplain configuration which allows the slow shallow water and slower current needed for establishing emergent vegetation.

Backwater marshes may also be affected by the daily and seasonal water fluctuations in that the value of some of those backwaters may be reduced due to the changes in water levels. These changes in water levels could affect temperature and other water quality considerations, as well as the establishment of marsh vegetation.

Direct effects caused by routine maintenance of river control structures are minimal, if any. Reclamation routinely avoids marsh areas with maintenance activities. Some disturbance to rails may occur if activities such as road maintenance, and riprap hauling and placement occur near areas occupied by rails.

Dredging at the headworks of the All-American Canal and Gila Gravity Main Canal involves removing the accumulated sediment in those locations. The dredged material is placed in the California Sluiceway and sluiced downstream to the Laguna Dredge Basin during routine sluicing operations. Impacts to Yuma clapper rail during the dredging may occur as a result of disturbance to rails in the cattail habitat located proximate to the area being dredged. There is no dredging in the cattail habitat.

Minimal, if any, direct effects to the Yuma clapper rail are expected by the maintenance dredging of the Laguna Dredge Basin. The dredge basin is not located at or near habitat preferred by Yuma clapper rail. The dredged material is placed on areas which contain dredged material from previous dredge basin maintenance.

Direct effects to the Yuma clapper rail in the Cienega may occur if the YDP becomes operational at one-third capacity during the next 5 years. However, due to the fact the impacts to the Yuma clapper rail would occur in Mexico, separate consultation conducted through the IBWC would be conducted. Operation of the YDP involves international treaties and agreements such as theNorth American Agreement on Environmental Cooperation, and Minute 242. The Unites States and Mexico governments entrust the application of these treaties and agreements to the IBWC. The U.S. Government depends on a close partnership between the United States side of IBWC and DOI to ensure that the U.S. Government meets these obligations and preserves the rights contracted in these agreements.

The Cienega is located approximately 60 miles south of the U.S./Mexico Border. It is a large wetland maintained by bypassed irrigation return flows from the WMIDD east of Yuma, Arizona. This wetland comprises some 10,600 acres of cattail-bulrush habitat. Should the YDP become operational at one-third capacity, approximately 2,300 acres of this habitat could be lost unless measures were taken to provide replacement water of such a quantity and quality to ensure the present size of the wetland is maintained. If the YDP becomes operational, measures will be undertaken to preserve the rail habitat in the Cienega.

Hunter's Hole, a small wetland complex located south of Gadsen, Arizona, is maintained by a siphon from the bypass canal. If the YDP operates at a one-third capacity, the water entering Hunter's Hole will increase in salinity from an average of 3,100 ppm to 3,560 to 3,700 ppm. This will not be expected to impact the cattail-bulrush habitat which occurs in Hunter's Hole.

Indirect Effects - Indirect effects of routine operations become speculative. That is to say, "what if" the banklines and river control structures weren't maintained? To follow this further, the "what if" question also applies to controlling flooding along the river.

To address the first question, maintenance of banklines and river control structures prevent the river from meandering and the subsequent formation of marsh habitat. The degree to which marsh habitat would be formed would depend upon the location of the meander and the tendency for the river to form another channel away from the newly formed marsh habitat. Historic conditions, however, indicate large permanent marsh areas weren't the rule along the lower Colorado River. However, it could be speculated there is some indirect effect from bankline and river control structure maintenance, which prevents uncontrolled river channel changes.

The second question, "what if" flooding were not controlled on the lower Colorado River is also very speculative. Certainly during the high flows of 1983 through 1985 some new marsh areas were formed, but many more were severely degraded due to sediment deposition and subsequent lowering of the water surface due to main channel scouring. However, it must be conceded a slight indirect effect may occur to marsh habitat through lack of new marsh formation, and subsequently the population and range expansion of marsh dwelling inhabitants such as the Yuma clapper rail, by controlling flooding.

Based on the above effects analysis, it may be concluded Reclamation's discretionary operations on the lower Colorado River may affect, but not adversely affect, the Yuma clapper rail.

Cumulative Effects - Cumulative effects are defined for this purpose as the effects of future State, local or private actions that are reasonably certain to occur in the action area. The future, in this case, applies to the 5-year period this assessment covers.

Cumulative effects may occur as a result of delivering a major portion of water to Mexico through the Pilot Knob and Siphon Drop Powerplants. Through this activity some of the water for delivery to Mexico is diverted into the All-American Canal at Imperial Dam and delivered back into the lower portions of the Yuma Division after being used for power production. This results in depleted flows in the upper portion of the Yuma Division. Further explanation of this diversion is found in Appendix D. If the concept that more water means more marsh habitat, then the depletion of water may be indirectly keeping marsh from forming in the upper portion of the Yuma Division. However, marsh formation is also dependent on other features, such as the physical configuration of the river channel and associated floodplain. This, coupled with controlled flooding, makes evaluating the probability of an indirect impact from the water delivery to Mexico through the powerplants difficult at best.

It is reasonably certain growth and development in areas such as Laughlin, Nevada, and Bullhead City, Arizona are going to continue. This would result in more people using the river for recreational activities such as boating, hunting and fishing, and subsequent disturbance to marsh dwelling species such as the Yuma clapper rail. This disturbance could be in the form of unknowing disturbance or creating wave action which could affect nests. Agencies which control these types of water-based activities include State Resource Departments, the U.S. Coast Guard, and FWS, depending on jurisdiction at specific areas.

Cumulative effects on Yuma clapper rails from Mexico's actions over the next 5 years are not known at this time. For the present, the Mexican Government has declared the Cienega the core area of the world's largest biosphere reserve. Therefore, it can be expected the Yuma clapper rails occupying that area would not be impacted by other Mexican actions. Effects of Mexico's actions on other areas of Yuma clapper rail habitat, such as the confluence of the Rio Hardy and Colorado River are unknown.

Selenium in the lower Colorado River comes from above Davis Dam. The source is either natural weathering of seleniferous shales, combustion of high selenium coal at electrical generation stations, extraction of uranium and coal ore, or upstream irrigation-based agriculture (Radtke et al. 1988). If the source of the selenium can be identified, the appropriate regulating agency may be able to take action, however, the source of the selenium in the lower Colorado River is unknown at this time. The effect of the selenium on Yuma clapper rail is unknown at this time, but over time the accumulation of selenium in a form which can be ingested by Yuma clapper rails may affect them.

2. Sensitive

a. California Black Rail (*Laterallus jamaicensis coturniculus*)

Description and Life Requisites

This is a plump, short-necked bird with a black, chicken-like beak, long legs and toes, and a stubby tail. Both males and females exhibit slate black plumage with narrow, white barring on the back and flanks and a chestnut nape. Juveniles look much the same as adults, but their eyes are brown or olive rather than red like those of adults. Full grown birds measure about 5 to 6 inches in length.

The life history and status of the California black rail are poorly known (Wilbur 1974, Todd 1977, Evens et al. 1991), due to its secretive nature and tendency to inhabit densely vegetated marshes. The preferred habitat of the California black rail is characterized by minimum water fluctuations that provide moist surfaces or very shallow water, gently sloping shorelines, and dense stands of marsh vegetation (Repking and Ohmart 1977). California black rails are most often found in areas where cattails (*Typha* sp.) and California bulrush (*Scirpus californicus*) are the predominant plant species (Rosenberg et al. 1991). While California black rails are more commonly associated with cattail and bulrush, habitat structure as described above was more effective than plant composition in predicting California black rail use of habitat. Water depth appeared to be a limiting factor, as the California black rails prefer shallow water (Flores and Eddleman 1995). The breeding season along the lower Colorado River extends from April through July (Flores and

Eddleman 1995). California black rails eat mainly insects and some seeds (Rosenberg et al. 1991).

Distribution and Abundance

This subspecies of California black rail occurs along the California coast from Tomales Bay in Marin County, south to San Diego and Baja California. It also occurs in interior California around the Salton Sea and along the Colorado River from Imperial National Wildlife Refuge south to the International Boundary (Peterson 1990; Rosenberg et al., 1991). Historically, the California black rail primarily occurred along the California coastline. In the mid-1970s, an estimate of between 100 and 200 individuals was given for the area between Imperial National Wildlife Refuge and Mittry Lake, Arizona (Repking and Ohmart 1977). No quantitative data are available on the current populations of the California black rail along the lower Colorado River. Various agencies including BLM and FWS survey California black rail concurrently during surveys for the Yuma clapper rail.

Effect Analysis

The California black rail is a marsh-dependent species. A discussion of marsh dynamics along the lower Colorado River is included in the effect analysis for the Yuma clapper rail. That discussion concludes marsh areas along the lower Colorado River are more extensive and permanent than occurred historically.

Reclamation's policy for routine maintenance activities (i.e., bankline repair and stabilization of small reaches of bankline) is to avoid marsh areas completely. Therefore, the maintenance activities would also not be expected to degrade the existing marsh areas.

Based on the current marsh dynamics along the lower Colorado River, it would be concluded Reclamation's routine operation and maintenance activities will not affect the continued existence of the California black rail occurring along the lower Colorado River.

b. Western Least Bittern (*Ixobrychus exilis hesperis*)

Description and Life Requisites

The western least bittern is a subspecies of least bittern. The species feeds on fish, amphibians, insects, small mammals, and possibly young birds or eggs (Ehrlich et al. 1988).

Distribution and Abundance

It is a local breeder in southern Oregon, interior and southern coastal California, along the lower Colorado River, south into central Baja California, and southern coastal Sonora, Mexico (American Ornithologists' Union 1983; Peterson 1990). It is a locally common breeder along the lower Colorado River from April through September (Rosenberg et al. 1991). The largest populations of least bitterns occur where they nest in emergent marsh vegetation and are most common in extensive cattail (*Typha* sp.) and bulrush (*Scirpus* sp.) marshes.

Effect Analysis

The least bittern is a marsh-dependent species. A discussion of marsh dynamics along the lower Colorado River is included in the effect analysis for the Yuma clapper rail. That discussion concludes marsh areas along the lower Colorado River are more extensive and permanent than occurred historically.

Reclamation's policy for routine maintenance activities (i.e., bankline repair and stabilization of small reaches of bankline) is to avoid marsh areas completely. Therefore, the maintenance activities would also not be expected to degrade the existing marsh areas.

Based on the current marsh dynamics along the lower Colorado River, it would be concluded Reclamation's routine operation and maintenance activities will not affect the continued existence of the least bittern occurring along the lower Colorado River.

c. White-faced Ibis (*Plegadis chihi*)

Description and Life Requisites

The white-faced ibis feeds on crayfish, other invertebrates, and small fish in marshes, irrigated fields, and shallow backwaters.

Distribution and Abundance

The white-faced ibis is an uncommon to fairly common transient and winter visitor to the Salton Sea and lower Colorado River areas (Garrett and Dunn 1981; Rosenberg et al. 1991). Along the Colorado River, small flocks have been observed from March through May and from July through October, with a few individuals residing through the winter (Rosenberg et al. 1991).

Effect Analysis

The white-faced ibis is a marsh-dependent species. A discussion of marsh dynamics along the lower Colorado River is included in the effect analysis for the Yuma clapper rail. That discussion concludes marsh areas along the lower Colorado River are more extensive and permanent than occurred historically.

Reclamation's policy for routine maintenance activities (i.e., bankline repair and stabilization of small reaches of bankline) is to avoid marsh areas completely. Therefore, the maintenance activities would also not be expected to degrade the existing marsh areas.

Based on the current marsh dynamics along the lower Colorado River, it would be concluded Reclamation's routine operation and maintenance activities will not affect the continued existence of the white faced ibis occurring along the lower Colorado River.

d. Fulvous Whistling Duck (*Dendrocygna bicolor*)

Description and Life Requisites

The fulvous whistling duck has a deep tawny yellow head and underparts, with a dark back and wings. The bill is dark, almost black; legs and feet have a dull bluish tone and the rump is white. The neck has white side streakings. It flies with a slightly drooped neck, long legs extending beyond the tail, and slow wingbeats for a duck. Its preferred habitat is marshy areas (Rosenberg, et al. 1991)

Distribution and Abundance

The fulvous whistling duck is a rare visitor to the lower Colorado River. There have been only four recorded observations along the river since 1970 (Rosenberg et al. 1991). The species breeds and winters from South America to the southern United States. It is an uncommon breeder in the Salton Sea area (Garrett and Dunn 1981). The fulvous whistling duck prefers stands of dense cattails adjacent to shallow water. They can occasionally be observed in irrigated fields.

Effect Analysis

The fulvous whistling duck is a marsh-dependent species. A discussion of marsh dynamics along the lower Colorado River is included in the effect analysis for the Yuma clapper rail. That discussion concludes marsh areas along the lower Colorado River are more extensive and permanent than occurred historically.

Reclamation's policy for routine maintenance activities (i.e., bankline repair and stabilization of small reaches of bankline) is to avoid marsh areas completely. Therefore, the maintenance activities would also not be expected to degrade the existing marsh areas. Based on the current marsh dynamics along the lower Colorado River, it would be concluded Reclamation's routine operation and maintenance activities will not affect the continued existence of the fulvous whistling duck occurring along the lower Colorado River.

D. Aquatic

1. Endangered

a. Colorado Squawfish (*Ptychocheilus lucius*)

Description and Life Requisites

The Colorado squawfish is considered the world's largest minnow, reaching lengths up to 5 feet. It has a large long head, somewhat pike-like, with a terminal mouth. It was, historically, the top predator fish in the Colorado River. This species is the only member of the genus *Ptychocheilus* endemic to the Colorado River basin. The Colorado squawfish was once widespread in distribution, but native populations are now restricted to the upper Colorado River basin in Wyoming, Utah, Colorado, and New Mexico. The species is faring best in the Green and Yampa Rivers, where a reproducing population exists. The species was listed as endangered in 1967 and came under the protection of the Endangered Species Act in 1973.

Colorado squawfish are now considered extirpated from the entire lower basin, where it was once extremely abundant. The last known wild adults from the lower Colorado River were captured in the 1960s, and the last known specimens from the Gila River basin were collected in 1958 (Minckley 1973).

The species decline in the lower basin began as early as 1900 and appears to be due to several factors associated with man's development of the arid basin. As reported in Minckley (1973), which quoted the 1904 field notes from F.W. Chamberlain, copper mining impacted this species in the Gila River drainage :

> "Several years ago fish were abundant (near Safford, Graham County, in the Gila River). Then pools of sufficient depth for men to swim in existed. Salmon reached a weight of 35 lb., humpback and other suckers were abundant. None of these has been taken in the last two years. It is believed that minerals and concentrate-wash from the mines and works at Morenci and Clifton have killed the fish."

Agriculture in the lower Colorado River basin depends heavily on diversion of river water to irrigate cropland. The first major water diversion was the Alamo Canal, finished in 1901. It delivered water to the Imperial Valley of southern California. An example of how irrigation diversions in the Imperial Valley affected Colorado squawfish, locally known as "salmon," and other native fishes was reported by Miller (1961 *in* Minckley 1973):

> "Until about 1911, the species was so abundant in the lower Colorado that individuals got into the irrigation ditches and were pitchforked out onto the banks by the hundreds for use as fertilizer. Vast numbers of 'salmon,' bonytails, and humpback suckers perished in this fashion or died when they were unable to re-enter the river from the irrigated lands..."

Construction of mainstream dams began along the lower Colorado River with Laguna Dam, completed in 1909. Additional mainstream dams, most notably Hoover Dam, were constructed between 1935 and 1950. These structures certainly presented barriers to migration of native fishes. Radiotelemetry studies have shown that Colorado squawfish move up to 200 miles to reach spawning areas in the Green River basin (Tyus 1985). Minckley (1979) suggests that post-spawning, downstream migration of Colorado squawfish may have occurred in concert with the summer/fall abundance of striped mullet in the lower river.

Finally, the expansion of nonnative fishes following dam construction during the 1930s coincided with the decline of this and other native species as reported in Dill (1944). These species had both direct effects (McAda 1983) and indirect effects on Colorado squawfish (Karp and Tyus 1990).

The Colorado Squawfish Recovery Plan (FWS 1991) suggests that the only potential way to recover this species in the lower basin would be through stocking programs. The plan supports stocking fish in the lower basin for experiment and research. An experimental reintroduction for Colorado squawfish into streams in the Gila River basin was approved in July 1985 (FR Vol. 50 No.142, 1985), and reintroductions as "experimental nonessential" populations have been carried out in central, interior Arizona, primarily in the Verde River. No reintroductions have been made or approved for the mainstream Colorado River in the lower basin, but a proposal was made for an experimental reintroduction into the Colorado River near Parker, Arizona (FR Vol.49 No. 70, 1984). While the proposal was made in 1984, no final action was ever taken, and no reintroductions are presently planned for this species into the mainstream Colorado River.

Effect Analysis

Due to its extirpation from the lower Colorado River and lack of plans for reintroduction of this species into the mainstream river during the period of time covered by this consultation, we believe that routine operation will not affect this species.

b. Razorback Sucker (*Xyrauchen texanus*)

Description and Life Requisites

The razorback sucker is a large fish, reaching over 2 feet in length and 8 pounds in weight. Sexual dimorphism is present, with males being smaller, slimmer, and having larger fins than females. During the breeding season males have nuptial tubercles covering posterior fins and portions of the body. Females tend to be larger, heavier-bodied and have fins that are somewhat smaller in proportion to their body size (Minckley 1973).

During the non-reproductive season adults may be found widely dispersed throughout lakes and in riverine sections. Radiotelemetry work in both the upper and lower basins show wide ranges in movement. However, some individuals were relatively sedentary and over the course of a year strayed no more than a few miles from their original point of capture (Minckley et al. 1991).

Reproduction in the lower basin has been studied in Lakes Mead and Mohave. Spawning in Lake Mohave typically begins in January or February, while in Lake Mead it begins slightly later (Jonez and Sumner 1954). Spawning typically runs 30-90 days, at water temperatures ranging from 55° to 70° F. In reservoirs, spawning aggregations can contain up to several hundred fish. Spawning areas tend to be wave-washed, gravelly shorelines and shoals. Fish spawn in water from 3 to 20 feet in depth with the majority of fish in the 5-10 foot range. Razorback suckers apparently spawn continuously throughout the spawning season, with females releasing only a portion of their gametes at each event. Spawning occurs both day and night on Lake Mohave (USBR, file data). There is considerable fidelity based on recapture data, and fish often show up on the same spawning site year after year (Minckley et al. 1991). Recent sonic tracking data on Lake Mohave showed some fish visiting three or four spawning sites in a single season (Gordon Mueller, pers. comm.).

The following observations on Lake Mead by Jonez and Sumner (1954) clearly describe the spawning act:

> "The period of spawning activity of suckers in Lake Mead was between the 1st of March and 15th of April.... The areas of spawning activity seemed widespread about gravel shores.... A number of male suckers were seen to converge upon a ripe female. They completely surrounded her, then closed in upon her sides. At the proper time a convulsive movement spontaneously erupted throughout the formation. This movement resembled the effects of a mild electric shock, and was a series of rapid successive sidewards undulations. The duration of these convulsions usually was approximately one-half minute. During this time the spawning act, extrusion of eggs and milt, was consummated. The unit then normally moved away in a less confining formation. No attempt was made to guard the nest site. In a number of instances the same female was observed to consummate this action several times during an hour or so. This was accomplished with the same and/or other male suckers in attendance."

Eggs hatch in 5 to 10 days depending on water temperature. Optimal hatching success is around 68°F; hatching does not occur at extremes of cold or hot (50° or 86°F) (Marsh and Minckley 1985). Larvae swim up within several days and begin feeding on plankton. As the terminal mouth migrates to a sub-terminal position, larvae begin to feed on benthos as well. Growth is variable. Within a single cohort some individuals may attain 14 inches in length in their first year while others may not reach 7 inches. Males generally reach maturity in their second year, and females mature at 3 years of age. However, sexual maturity has been noted for males at 10 months of age for fish raised in backwaters of Lake Mohave by the NFWG (USBR, file data).

Larval stages of razorback suckers are positively phototactic and readily come to bright lights suspended over spawning sites at night. Fish up to three-quarters of an inch have been captured by this technique. Older juveniles (generally over 1 inch) switch from being positively phototactic to being negatively phototactic, or nocturnal. Juvenile razorback suckers in lakeside rearing ponds hide during the day in dense aquatic vegetation and under brush and debris and in rock cavities (USBR, file data). It is not known at exactly what age/stage/size the nocturnal behavior ends. Adults are found throughout the river/reservoir system during non-spawning periods and are observed during daytime hours all year long. Intuitively then, the nocturnal behavior must end by the fish's first spawn because spawning behavior occurs both day and night during the spawning period.

These observations on nocturnal behavior, as well as the documented rapid growth in predator-free rearing ponds, suggest that razorback sucker used two strategies to avoid predation by historical predators such as the Colorado squawfish. They hid during the day, and they grew quickly.

Distribution and Abundance

The razorback sucker was formerly the most widespread and abundant of the big-river fishes in the Colorado River. It ranged from Wyoming to northwestern Mexico and occurred in most of the major tributaries (Minckley et al. 1991). Early explorers report the fish as extremely abundant (Gilbert and Scofield 1898). In central Arizona it was abundant enough to be commercially harvested for human and animal food and for fertilizer in the late 1800s. Similar abundances have been noted for the upper basin (Bestgen 1990). Today the species occupies only a small portion of its historical range, and most occupied areas have very low numbers of fish. The razorback sucker was listed as an endangered species in October 1991 (FR Vol.56 No. 205, 1991).

Distribution along the lower Colorado River is briefly summarized as follows. In Lake Mead the fish were abundant for many years after the reservoir filled but greatly declined during the 1960s and 1970s. Only 66 adult razorback suckers were contacted in Lake Mead between 1962 and 1980. Since 1981, only 50 fish have been captured; however, one of these fish was a juvenile. Most of these fish are found during the March spawning season and primarily come from either Las Vegas Bay or Echo Bay. An occasional fish is captured in the upper reaches of the Overton Arm near the Moapa and Virgin River inflows (Sjoberg 1995)

Lake Mohave has the largest single population, currently estimated to contain less than 25,000 adults. This population was estimated to be 60,000 fish as recently as 1987 (Marsh 1994). The rapid decline for the Lake Mohave population was predicted by McCarthy and Minckley (1987). They aged a large sample of adult fish taken from Lake Mohave. Of the fish they aged, the youngest was 24 years with the oldest 44. Eighty-eight percent of the fish they aged hatched prior to or around the time Lake Mohave was constructed and filled. They reported that in other reservoirs in the Colorado River basin, razorback suckers had drastically declined around 40 years after closure of the dam and filling of the reservoir. They predicted that a similar event would occur on Lake Mohave by the turn of the century. In an effort to replace this aging population before it underwent complete collapse, an interagency team of biologists began rearing fish in protected lakeside ponds in 1992. Between 1992 and 1995, this group, NFWG, has reared over 5,000 juvenile razorback suckers and returned them to Lake Mohave .

For the entire reach of the Colorado River downstream of Lake Mohave, including associated backwaters and side channel habitats (except Senator Wash Reservoir), confirmed records exist for capture of only 42 adult razorback suckers between 1962 and 1988 (Marsh and Minckley 1989). Numerous reintroductions of larvae, juvenile and adult razorback suckers have taken place during this same period. Observations on adults and reintroductions are discussed below for each reach of the lower Colorado River.

Immediately below Davis Dam, a few adult fish are seen (and sometimes captured) almost every year, but no estimate of the population size can be made (Burrell, pers. comm.). Between Davis Dam and Lake Havasu observations of razorback suckers are extremely rare. CFG conducted a fishery survey of 15 backwaters between Davis Dam and Lake

Havasu in 1976 and captured 3 adult razorback suckers (Marshall 1976). These areas were surveyed by CFG and Reclamation personnel in 1983, and no razorback suckers were captured or observed. CFG stocked approximately 400,000 larval razorback suckers into this reach of the river during 1985 (Ulmer 1987).

In Lake Havasu, observations on adults are again, extremely rare, with only 16 adults captured or observed since 1962. Open water sampling for fish eggs and larvae as part of a striped bass study by CFG resulted in the capture of 37 larvae razorback suckers in 1985-86 (Marsh and Papoulias 1989). Flow data for Lake Havasu suggest that the larvae hatched out either within the upper end of Lake Havasu or in the Colorado River inflow area to the lake. Two larval and three adult razorback suckers were entrained into and captured within the CAP canal between 1987 and 1989 (Mueller 1989a). An interagency native fish rearing and stocking program has been initiated on Lake Havasu as part of an ongoing Lake Havasu Fishery Improvement Project. Patterned after the NFWG's program on Lake Mohave, the project has reared and/or stocked over 1,000 razorback suckers and bonytail into Lake Havasu since 1992.

Below Lake Havasu, adult razorback suckers are again, very rare. Dill (1944) reported the largest single capture of adults within the lower river since closure of Hoover Dam, when he captured 13 fish below Headgate Rock Dam in 1942. Larval razorback suckers have been stocked by CFG in 1986 into backwater areas connected to the main channel below Headgate Rock Dam. Two larvae razorback suckers were captured during a fish passage study at Headgate Rock Dam in 1988 (USBR, file data). Thirty eight juvenile razorback suckers were captured in 1987 in the CRIT canal system, which diverts Colorado River water at Headgate Rock Dam. These fish were most likely a result of fish stocked in 1986. Three adult fish were captured in 1988 in the same canal and aged by ASU as 3, 4, and 7 years old. They did not coincide with any stocking and were concluded to have been naturally produced within the system (Marsh and Minckley 1989). Juvenile razorback suckers are being reared in ponds of the Emerald Canyon Golf Course near Parker, Arizona, by FWS for reintroduction into the Colorado River.

Over 250,000 juvenile razorback suckers were stocked into the river and into backwater areas between Headgate Rock Dam and Imperial Dam by CFG in 1987-88 (Langhorst 1988, Langhorst 1989), and nearly 500,000 larval razorback suckers were stocked into the river and backwaters (Ulmer 1987). Razorback suckers are being reared in the old river channel impoundment known as "Pretty Water" on Cibola National Wildlife Refuge downstream of Blythe, California. Over 100 fish have been reared to ten or more inches in length and released into the river during 1996 (C.O. Minckley pers. comm.).

Razorback suckers were reported from the Senator Wash Reservoir, a pump-back storage facility, during the 1970s. Exactly when these fish accessed the reservoir, and at what size, is not known. The reservoir was filled in 1966, but the earliest record of a razorback sucker in Senator Wash Reservoir was seven adults captured in a gill net in 1973. The population in the reservoir was estimated to be about 55 adults. No fish from this population were aged. Fish did annually spawn and produced larvae, but there was never any indication of recruitment into the adult population (Ulmer and Anderson 1985). Attempts to locate these fish in 1988 and 1989 were unsuccessful, and it is believed this small population had died off (Paul Marsh pers. comm.) Adult razorback suckers from Niland State Fish Hatchery ponds were transferred to Senator Wash Reservoir in1990 after the hatchery was closed. CFG netted these fish during monitoring activities in the of spring 1996, capturing 100 of these fish, all of which were in excellent condition (CFG, file data.).

Razorback suckers are occasionally captured or observed in the All-American and Coachella Canals, laterals and sumps during outages for maintenance.

The pattern of decline for the razorback sucker in lower basin reservoirs has been as follows. Upon initial impoundment, razorback suckers expand their population into the newly flooded reservoir basin. Over the next 30 or so years fish are observed spawning along gravel shorelines in late winter and early spring. Fishery managers believe there is recruitment to adulthood because of the abundance of fish, despite the lack of observations of juvenile fish. However, recruitment to the adult life stage does not occur due to predation from nonnative fishes, and the population gets older and eventually collapses as fish die of old age and natural causes.

This scenario was played out in Lake Roosevelt and Saguaro Lake on the Salt River and in Lakes Mead and Havasu on the Colorado River. In all cases, 40 to 50 years after dam completion, the reservoir populations completed a boom-and-bust cycle and were left with small remnant populations. This scenario is being played out today at Lake Mohave.

No single introduced species is responsible for the lack of recruitment. On Lake Mohave for example, razorback suckers spawn from January through April, which is the earliest of all the fish species in the reservoir. Adult razorback suckers are passive and provide no protection of the fertilized eggs. Upon release of gametes, the adults swim away and carp can be observed moving to the site of the released eggs. Carp have been captured and sacrificed at the site, showing their stomachs to contain gravel and fish eggs (file data, USBR). Those eggs that survive and incubate to hatching yield prolarvae that only have pectoral fins and are relatively poor swimmers. The preceding year's crop of young sunfish, only a few centimeters long themselves, can be observed feeding on the emerging larvae.

After observing spawning razorback suckers on Lake Mohave in 1954, Jonez and Sumner (1954) make the following report:

> "Very small fish (about three-quarters inch long, threadlike, and translucent) which appeared to have been humpback suckers, were observed in the areas where the above described spawning took place. It is doubtful whether very many of those tiny humpback suckers survived because they were mingling with predaceous small bass and sunfish."

Juvenile suckers that survive past the larval stage take on a nocturnal behavior pattern, hiding during the day in weeds, brush, and rock crevices and caverns. Unlike historical times, they now must share these hiding places with nonnative, nocturnal predators, such as channel catfish. During dawn and dusk, when young fish emerge from their hideouts, they are preyed upon by ambush predators such as largemouth bass. Occasionally, some fish do survive and individuals are still caught in some of these impoundments. Regardless of what percentage of fish do make it to adult life-stage, the numbers have not been sufficient to sustain the populations.

Today, razorback suckers are only infrequently encountered in the Colorado River below Lake Mohave, and nothing is really known of the current population status although it is thought to be extremely low, on the order of a few hundred individuals or less. From 1974 through 1976, Minckley (1979) conducted extensive fish surveys in the Colorado River from Davis Dam to the border with Mexico, handling over 75,000 fish. No razorback suckers were encountered, despite using a wide variety of active and passive sampling techniques, including poison. Additional surveys conducted by Reclamation between 1983 and 1986 below Headgate Rock Dam (Hiebert and Grabowski 1987) and by ASU near Yuma, Arizona (Marsh and Minckley 1985), sampled over 10,000 fishes representing 17 species, but the samples failed to capture a razorback sucker.

As stated in Minckley et al. (1991):

> "The only substantial numbers of juveniles resulting from natural spawning in the 1980s were caught from irrigation canals and ponds downriver from Parker Dam."

Why and how this occurs is not known for sure; however, one hypothesis is that the off-season shut down, and periodic drawdowns for maintenance actions on the irrigation systems, provides windows of opportunity wherein the nonnative fishes are reduced or eliminated long enough for a few native fish to grow large enough to avoid most predators.

Numerous attempts to stock razorback suckers in the lower river have met with limited success. Langhorst (1988, 1989) reports on several stockings in the lower Colorado River, all of which have met with almost no success. Several million larvae have been introduced with no noted survival. Larger fish raised in some backwaters appeared to do better, but predation rates remain high. Similarly, of the tens of thousands of young razorback suckers stocked into the Gila River the overwhelming majority were lost due to predation by catfish (Marsh and Brooks 1989).

Minckley et al. (1991) concluded that lack of recruitment to adulthood was the primary limiting factor for razorback suckers today, and that predation by nonnative fishes was the single most likely factor precluding recruitment of razorback suckers in nature. The authors stated:

> "The strongest evidence that predation is the major factor in loss of larval razorback suckers is simply that larvae persist and grow, to maturity if given adequate time in habitats from which predators are excluded."

Effect Analysis

Much of the lower Colorado River must be considered as occupied habitat for some life-stage of the razorback sucker, both wild and reintroduced fish. Therefore, it would not be remarkable to encounter a larval or adult fish anywhere in the mainstream river between Grand Canyon and Yuma, Arizona. Because of the significant differences in their makeup, reservoirs, river reaches, and water control features are each considered separately, below.

1) Mainstem Reservoirs:

Direct Effects - Lakes Mead, Mohave and Havasu have been occupied by razorback suckers since their formation. As the reservoirs filled, razorback suckers must have initially been successful inrecruiting fish to the adult life stage because their populations did initially expand. The spawning process described earlier continues today on Lake Mohave. Biologists have captured over 100,000 razorback sucker larvae from the reservoir, indicating that both spawning and incubation of eggs has been successful over the wide range of reservoir operations during that period. However, despite these hundreds of thousands of spawning acts and production of hundreds of thousands of larvae, the reservoir population has not been able to replenish itself, and over 50 percent of the adult population has died of old age during the last 10 years. On Lakes Havasu and Mead, only remnant populations exist and without help; extirpation is only a matter of time.

The routine operation of Lakes Mead, Mohave, and Havasu is not likely to adversely affect the razorback sucker. This is due to the anticipated limits of reservoir fluctuations over the next 5 years. The only type of activity with potential to harm these fish would be a rapid drawdown during the spawning season, but measures have been incorporated into the routine operation of Lake Mohave to assure that these impacts will not happen except in an emergency. The average nesting of razorbacks occurs in 3-15 feet of water, and egg incubation takes 5-10 days. Lake Mead is a large reservoir and is not anticipated to undergo a water level change greater than 2 feet in any 10-day period during the razorback spawning period. On Lake Mohave, Reclamation has modified its operations and does not lower the water level more than 2 feet in any 10-day period during the spawning season. (Reclamation consulted with FWS on the effects of these water level changes, and FWS agreed that the water-level regime was not likely to adversely affect razorback suckers.) Lake Havasu has a very narrow, vertical operational range and is not expected to affect any potential spawning.

Indirect Effects - Routine operation and maintenance assures the existence of the reservoirs, thereby assuring the continuation of extant populations of nonnative fishes which prey on young razorback suckers. Therefore, operation of the reservoirs may indirectly affect razorback suckers. However, many of the nonnative fishes present in these reservoirs are capable of sustaining, and do sustain, populations in both reservoir and riverine reaches and would be present if the reservoirs were removed.

Cumulative Effects - Recreation activities such as fishing, swimming, boating, and camping on these reservoirs is expected to continue during the period of this consultation. These recreation activities may harass razorback suckers in spawning areas during the spring.

2) Riverine Reaches:

Direct Effects - Limited observations of adult razorback suckers have been made in the river reach between Davis Dam and Lake Havasu, and between Parker Dam and Imperial Dam. Indirect evidence of spawning is provided in the periodic capture of young fish in canal systems and at structures which divert water from these reaches. Daily water level changes in these reaches expose gravel bars during the known spawning season for razorback sucker. While the probability of these water level changes affecting incubating eggs of razorback sucker is extremely remote, the possibility does exist, especially in light of recent repatriation of the species through various interagency rearing and stocking programs. Therefore, it must be concluded that the routine operation of the river reaches may affect razorback sucker.

Reasons for the statement that this possibility is "extremely remote" are as follows. Historically,these reaches were mostly shifting sand bottom, which would be poor quality spawning habitat. Today, most of the entire reach has large areas of clean gravels available for spawning, and most of these are not exposed during daily flow changes. Adult razorback suckers spawn over an extended period and spawn both day and night (file data, USBR). Water level changes happen everyday in these reaches, and it is highly unlikely that these fish would be unaware that the river is moving up and down. The rate of change is greatest near the dams, and spawning gravels are available along most of the river's course, especially where desert washes enter the river and provide debris fans.

Finally, if such an effect would occur, it would be inconsequential to the continued existence of these fish. The primary limiting factor for these populations is nonnative fish predation, and the annual production of even tens of thousands of eggs and larvae have not been sufficient to stem the predation losses in Lakes Mead and Mohave. Similarly, the stocking of tens of thousands of larvae and small juveniles into these reaches of river over the last decade have not resulted in increased abundance of the species.

Indirect Effect - Similar to reservoirs, maintenance of the riverine reaches as conduits for water delivery assures habitats for the continued existence of nonnative fishes which, through predation, may affect the razorback sucker. However, these populations are so entrenched into the aquatic ecosystem of the lower Colorado River that there is no practical means to eliminate or curtail their existence. Some of these fishes occurred prior to water and power resource development on the river, albeit their numbers may have been significantly less than what occurs today.

Cumulative Effects - Continued population growth in areas along the lower Colorado River will increase human activities such as agricultural development, habitat alteration, and waterborne recreation which may affect razorback suckers.

3) Water Control Facilities:

The lower Colorado River has a number of storage, hydropower, and diversion facilities. These have been discussed in the text and in Appendices D and E. They are either federally or non-federally operated. Primary actions which can cause harm to endangered fish by these types of operations are impingement, entrainment, and removal from the system. Impingement is generally associated with screening for cooling water. As the hydropower operations are not fossil-fuel generated, they use a minimum of cooling water, and impingement is not an issue in the lower Colorado River system.

Direct Effects - It is probable that razorback suckers will be entrained in Reclamation-operated hydropower and pumping plant facilities. Some may successfully pass the structures. For example, adult razorback suckers were observed in the CAP Canal in 1986 which were suspected of having passed through open needle valves during pressurization of the pumping plants (Mueller 1989). But some are not expected to make it. For example, in 1991 Reclamation assessed pumping plants on the CAP Canal as potential lethal barriers to passage of stockable size triploid grass carp (2.25 inch minimum head width). Fish were released in pairs into each pump and retrieved with a recovery net at the discharge outlet after passage. No grass carp in the test groups of 38 and 40 fish survived passage through the small and medium pumps respectively, and 2 of 40 fish survived passage through the large pump (Nibling and Liston 1992). Based on this study, passage by adult razorback suckers through pumping plants has a high probability of being fatal at Reclamation-operated facilities. Such a probability is incidental and unquantifiable at this time.

Indirect Effects - Future reintroductions of razorback suckers throughout the system will subject them to the same potential effects of entrainment at federally-operated facilities.

Cumulative Effects - Population growth is expected to continue within the desert Southwest, and dependence on hydropower and water for a variety of municipal, industrial, and agricultural purposes will continue. Entrainment is expected to occur for all fishes at nonfederally-operated pumping and hydropower generation facilities, and passage through many of the powerplants and diversion pumps may cause injuries to fish. Data show that razorback suckers enter canal systems served by the river and are thus, subject to effects such as dewatering, water quality changes, and canal-side pumping and diversion. Consequently, these physical actions may affect the well being of the involved fish.

4) Effect Summary:

Through conservation measures described for the razorback sucker in Section II, the status and survival of this species in Lakes Mohave and Havasu will be substantially improved. The goal of this conservation effort is to have 50,000 new adults in Lake Mohave and 25,000 new adults in Lake Havasu by the Year 2000; Reclamation is committed to fund and assist in providing at least half of these numbers. Reclamation's various activities to accomplish this commitment have also been described in Section II. It is anticipated the Lake Mohave goal will be reached in 1997 or 1998. With such success, the baseline status of the species will be dramatically improved and the potential jeopardy status diminished.

In summary, the effect analysis for razorback sucker concluded that routine operation and maintenance activities may affect razorback sucker. In recent section 7 consultations (Table 8), FWS has agreed with Reclamation's not likely to adversely affect the species and critical habitat conclusions for Parker II, Hoover Dam Powerplant Uprating, and Lake Mohave elevation management for the razorback sucker preservation program. These consultations were used as part of the overall, cumulative assessment of operations and maintenance; and it is understood that the individual consultations did not apply to river-wide operations.

c. Bonytail (*Gila elegans*)

Description and Life Requisites

In appearance bonytail are gray to gray-green on the dorsal, with silvery sides fading to a white ventral surface. The fish is elongated and somewhat laterally compressed with a narrow caudal peduncle. A smooth predorsal hump is present in the adult form. Breeding males can be distinguished by reddish marks on the paired fins and the presence of tubercles anterior on the body (Vanicek 1967). Adults are from 11 to 13 inches in length, although larger individuals (up to 24 inches) are occasionally taken. Positive field identification between bonytail and other forms of *Gila* is quite difficult and often considered tentative. Further, the name bonytail was assigned in general to the genus *Gila* by many researchers; thus, its population status in historic times is far from certain in areas where a mix of *Gila* species occurs. However, this problem is associated more with upper Colorado River basin populations.

As a result of the rarity of this species, the biology of the bonytail is not well understood. Spawning of bonytail has not been observed in riverine habitats; but based on the appearance of ripe fish in the upper basin, spawning appears to occur during late June and early July. Spawning in the lower basin occurs from late spring to early summer (Wagner 1954). In Lake Mohave, schools of bonytail were observed over gravel reefs (Jonez and Sumner 1954) and along clean sandy bottoms. Bonytail have spawned in earthen ponds in captivity, including rearing ponds around Lake Mohave (USBR, file data) and on the La Paz County golf course near Parker, Arizona (C.O. Minckley, pers. comm.). Bonytail produce an average of about 50,000 eggs/per fish (Hammond, pers. comm.). Hatching success is greatest in water temperatures from 59° to 68°F (Marsh 1985). In the Green River, Vanicek and Kramer (1969) estimated fish to reach approximately 2 inches during their first year of life, 4 inches by the end of the second season, and approximately 6 inches by the end of the third season. Growth rates from young bonytail stocked into backwaters of Lake Mohave indicate substantially higher growth rates are possible depending on habitat conditions. During 1995, 4-inch fish were stocked into lakeside ponds in March and grew to over 12 inches by November (USBR, file data). Fish appear to feed primarily on zooplankton and insects.

Distribution and Abundance

The bonytail once ranged throughout the mainstream Colorado River and principal tributaries (Minckley 1973). They were still abundant in Lake Mead after the completion of Hoover Dam (Moffett 1943); however, by 1950 they were considered rare (Jonez and Sumner 1954). By the time concern was raised for this fish, it had disappeared from much of its range. Consequently, the species was listed as endangered by FWS in April 1980. The most recent recovery plan for the bonytail summarizes the fish's distribution as:

> "The bonytail chub is very rare. In the Colorado River Basin, few individuals have been found in the last decade, and recruitment is apparently nonexistent or extremely low." (FWS 1990)

Presently, bonytail are believed to be extirpated in the Colorado River from Glen Canyon Dam to Hoover Dam (McCall 1979). Small populations may still exist in the upper basin, but as mentioned earlier, there is much confusion in fish identification due to the similarity in physical appearances with some of the roundtail chubs. Like the razorback, the largest remaining population of bonytail in the entire Colorado River basin resides in Lake Mohave. Unlike the razorback, however, population data from Lake Mohave are incomplete because too few fish have been captured to allow for a credible population estimate to be made.

Whether or not wild fish remain in Lake Mohave is not known, and most likely it cannot be determined. There were at least nine augmentation stockings of bonytail into Lake Mohave between 1981 and 1991 (USBR, file data). These stockings total over 150,000 fish and have ranged in size from less than 1 inch (fry) to 4-inch juveniles. These fish all originated at Dexter National Fish Hatchery, New Mexico, and were descendants of bonytail adults captured from Lake Mohave. (One group of 1,162 fish came from CFG's Niland Fish Hatchery, where they were being reared, but had originated as fry from Dexter National Fish Hatchery.) Only a small percentage of these fish was ever tagged or in some way marked. As part of the NFWG effort on Lake Mohave fingerling bonytail from Dexter National Fish Hatchery have been stocked into predator-free rearing ponds around the lake and later stocked into the reservoir after reaching 10-12 inches in length. All of these later fish have been PIT-tagged. A few of these fish have been recaptured (USBR, file data).

Fish were occasionally taken from Lake Havasu prior to 1970, but no up-to-date information or recent captures exist other than recaptures of fish released by the HAVFISH program during the past 2 years. The historical population has most likely been extirpated. Efforts are being undertaken to reintroduce bonytail back to Lake Havasu from lakeside coves using young obtained from Dexter National Fish Hatchery. Several backwaters on refuges along the lower river are being used for similar reintroduction downstream of Lake Havasu (C.O. Minckley, pers. comm.).

Like the razorback sucker, the primary limiting factor for bonytail appears to be non-native fish predation of the early life stages (egg to subadult). This conclusion is based on the fact that when reintroduced at a large size, the fish survive in the reservoir, and when stocked into predator-free environments the young fish grow to adulthood.

How and when the predation occurs is not certain, but Jonez and Sumner wrote the following report after observing spawning bonytail in Lake Mohave in May 1954:

> "In May 1954, with the aid of shallow-water diving gear, a large population of bonytail was observed spawning on a gravelly shelf about ten miles below Eldorado Fish Camp. It was estimated that there were about 500 bonytails spawning in the quarter-mile of gravel. It appeared that each female had three to five male escorts. Neither males nor females dug nests, and the eggs were broadcast on the gravel shelf. No effort was made to protect the eggs by covering them with gravel or by guarding them. However, the eggs adhered to the rocks, and that gave them some protection..... Large schools of adult carp were intermingling with the spawning bonytail. No young bonytails were observed in the spawning area, and it is presumed that the carp ate most of the eggs."

As mentioned earlier, juvenile razorback suckers tend to hide during the day in areas that are now occupied by predators, and when they emerge from these hiding areas, they fall prey to ambush predators such as largemouth bass. It is not known whether bonytail juveniles are nocturnal and subject to the same predation pressures. Bonytail juveniles placed in a large backwater pond connected to Lake Mohave by a barrier net (Davis Cove) were readily eaten by largemouth bass, an ambush predator that normally feeds during dawn and dusk when fish would be immerging and emerging from cover (USBR, file data).

Effects Analysis

Direct Effects - Operation and maintenance of Lakes Mohave and Havasu are not expected to have any direct effects on bonytail. Operation of facilities may lead to the entrainment of the species in hydropower and pumping plant facilities.

Indirect Effects: Bonytail may be subject to the same indirect effects of predation described for the razorback sucker.

Through conservation measures described for the bonytail in Section II, the status of this endangered species will be substantially improved in Lakes Mohave and Havasu. The goal of this conservation effort is to have 25,000 new adults in each of the reservoirs by the year 2005; Reclamation is committed to fund and assist in providing at least half of these numbers. Almost 500 bonytail have been released to Lake Mohave by the NFWG, of which Reclamation is an active participant. This effort will be substantially accelerated in the coming years. With the expected success, the baseline status of the species in the two lakes should be substantially improved.

Cumulative Effects - The only cumulative effects expected to occur during the period of consultation are the continued growth of the human population along the Colorado River system and the increased water-borne recreation and other activities that may periodically disturb the fish. Bonytail may be subject to entrainment and diversion from the mainstream river and, thus, potentially suffer the consequences described for the razorback sucker.

2. Critical Habitat Description - Razorback Sucker and Bonytail

Critical habitat for the razorback sucker and bonytail was designated in March 1994. The critical habitat for the razorback sucker includes Lakes Mead and Mohave and the river reach between them. It also includes the Colorado River and its 100-year floodplain from Parker Dam to Imperial Dam including Imperial reservoir (Figure 3).

Critical habitat for bonytail includes the Colorado River from Hoover Dam to Davis Dam, including Lake Mohave. It also includes the Colorado River from the northern boundary of Havasu National Wildlife Refuge to Parker Dam, including Lake Havasu (Figure 3).

Critical habitat is a regulatory term used to describe requirements for certain species survival. It encompasses physical and biological features essential for survival and recovery of listed species. Within the context of this document, the components of critical habitat will be addressed jointly for each species. There are some differences in species requirements, but the system itself functions as a whole, so it should be addressed as a whole. For the endangered big-river fishes, critical habitat encompasses three major areas of consideration as follows :

Water - A quantity of water of sufficient quality (i.e., temperature, dissolved oxygen, contaminants, nutrients, turbidity etc.) that is delivered to a specific location in accordance with a hydrologic regime that is required for the particular life-stage of each species.

Physical Habitat - Areas of the Colorado River system that are inhabited or potentially habitable for use in spawning, nursery feeding and rearing, or corridors between these areas. In addition to river channels, these areas also include bottom lands, side channels, secondary channels, oxbows, backwaters, and other areas in the 100-hundred year floodplain, which when inundated provide spawning, nursery, feeding and rearing habitats, or access to these habitats.

Biological Environment - Food supply, predation, and competition are important elements of the biological environment. Food supply is a function of nutrient supply, productivity, and availability to each life stage of the species. Predation, although considered a normal component of this environment, may be out of balance due to introduced fish species in some areas.

Each aspect of a critical habitat may, in and of itself, explain some changes in the population status of the big-river fishes, but the interactions between, and cumulative effects of, the combined elements are also of important concern.

Effects Analysis

Native fishes historically lived under more severe extremes of conditions than are currently found. The most visible changes that have occurred along the lower Colorado River have been those associated with the construction of facilities.

The question to be answered is, "How does the delivery and movement of water through the system as a whole impact the water, physical environment, and biological environment needed by the razorback sucker and bonytail?"

-Water:

Routine operation and maintenance activities will not destroy or adversely modify the quality of water, a constituent element needed for the critical habitat of these fishes.

Water temperature is known to impact the ability of fish to spawn. However, this effect in the lower basin impacts only a localized area and does not account for why the species has declined across its entire range (Minckley et al. 1991). Hoover Dam, for example, releases cold, hypolimnetic water, which may impair the ability of some stage of the life-cycle to survive, but Mueller (1989b) documented spawning and presence of larvae in this reach of the river. There have been numerous accounts of razorback suckers and bonytail spawning downstream in Lake Mohave where water temperatures approach 80° F, yet the population still does not recruit.

Historically, water quality exhibited wide ranges for common physico-chemical parameters deemed important for fish (e.g. temperature, dissolved oxygen, pH, salinity). Water quality in reservoirs is more stable than it was historically due to the buffering capacity of large masses of water. Reservoir temperatures are relatively stable on a daily basis. Oxygen levels are within tolerable ranges, as are a host of other basic limnological characteristics such as pH and conductivity.

Mainstream dams desilt the water. Reduced turbidity downstream of dams is a factor related to initial construction, and it's impact is conjectural: less suspended sediment means less physical stress to fish, but clear water may accelerate predation. Lower turbidity means greater light penetration and more primary production, and removal of fines means cleaner spawning gravels and more attachment sites for benthic and sessile animals (secondary production).

Increasing salinity has been a major water quality concern on the lower river. Much of the increase in salt load is a result of agricultural drainage. Diversions result in less water in the river channel to dilute saline return flows. Increases in salinity along the mainstream Colorado River have not yet attained a level that would impact native fishes.

The potential exists for the concentration of other chemicals and toxic compounds besides salt. Selenium and several pesticides have been identified, but there are no data yet that demonstrate levels are high enough in the lower river to affect reproduction of native fishes.

As far as actual quantity of water, consistent low or high flows really do not differ from each other, because in either case the habitat stabilizes around the flow. Average seasonal patterns of water release, although not nearly of historical magnitude, follow the same general pattern, with the highest flows occurring in the spring and early summer. Potential adverse effects are limited to daily variation in these flows; however, as pointed out in the aquatic baseline section of this report, daily water level changes were recorded prior to any major development along the river (Grinnell 1914).

·Physical Habitat:

Historically, the stream bed through most of the lower Colorado River was shifting sand. Initial blockage of sediment by dam building caused armoring of the stream bed. The increases in potential spawning sites for native fishes has never been quantified, but intuitively they are very great. For example, there is about 44 miles of river channel between Headgate Rock Dam near Parker, Arizona, and Palo Verde Diversion Dam near Blythe, California. Historically this 44-mile reach was predominately shifting sand substrate. Placement of Headgate Rock Dam in 1941 caused channel cutting and armoring over this entire reach. Placement of Palo Verde Diversion Dam in 1957 caused some backing up of the river reach above it, and fine materials again were deposited. Today, coarse materials (gravels, cobbles, boulders) now comprise over 50 percent of the stream bed substrate for the first 32 miles below Headgate Rock Dam (Minckley 1979).

Routine operation causes fluctuations in the river which may expose gravel bars and desiccate incubating eggs. This action may adversely modify critical habitat for these fishes.

Short-term fluctuations in reservoir can destroy eggs of native fishes by exposing them to wave action or desiccation. In the three mainstream Colorado River reservoirs, it is unlikely Reclamation will lower the water level more than 2 feet in any 10-day period, thus preventing such an impact from occurring during the spawning period. Reclamation has adopted a 5-year management criteria on Lake Mohave for this purpose.

Changes in water levels drain backwater habitats, making these habitats unavailable for use by fishes. Artificial measures have been used to physically recreate backwaters in several reaches of the river. Some of these are potentially useful to fish, while many are separated from the river and require manual introduction and removal. On those backwater habitats left open to the river, maintenance dredging assures these habitats maintain enough water to be viable over the full range of water fluctuations.

Routine dredging at Laguna dredge basin adds siltation to the river and increases turbidity locally and immediately below the work site. State game and fish agencies normally request that Reclamation refrain from initiating these activities during spawning seasons for both game and nongame species. Reclamation has in the past complied with these requests. The actual removal of sand does not adversely affect critical habitat for these species since shifting sand bottoms are not normally used by these fishes.

Stabilization of banklines by adding a veneer of rock (called riprap) is a common maintenance activity. Historically, much of the shoreline was not vegetated because flooding often resulted in a denuded shoreline close to the water. Depending on conditions, there were probably many years where there was very little cover on the river. This may dramatically reduce recruitment success of natives, but given the life-histories of the big-river fishes (high fecundity plus longevity), they would not be expected to spawn successfully every year. Riprap provides interstices for hiding of both native and nonnative fishes. Whether this is beneficial or nonbeneficial is not known, and the issue is probably dogmatic.

·Biological Environment:

The biological environment has seen great changes. Prior to the 1900s the river held a depauperate fish fauna with only a few species dominating the assemblage (Minckley 1973, 1979). Today a diverse fauna exists in the lower river. There exists potential competition for resources and introduction of parasites and diseases. As cited earlier, predation by non-native species is accepted as the single most important factor limiting recruitment of native fishes (Minckley et al. 1991). For both razorback and bonytail, it appears the window of greatest susceptibility is during their first year of life (Minckley et al. 1991). Carp captured on razorback sucker spawning beds almost always have their stomachs packed with eggs. Small centrarchids, shiners, and shads have the potential to devastate larval razorback sucker and bonytail.

Routine operation and maintenance activities do not include management of nonnative fishes, and operations that are beneficial or nonbeneficial to introduced fishes usually affect native fishes similarly.

Summary of Effects Analysis for Critical Habitat

Based upon the available information regarding the critical habitats for these fishes and their life history requirements regarding occupation and uses of those critical habitats, it is concluded that routine operation and maintenance activities may adversely modify critical habitat for the bonytail and razorback sucker in the lower Colorado River by temporarily dewatering spawning and other habitats. The exposure of spawning bars will occur; however, the effects are short-term, temporary and immeasurable to the species because of the abundance of spawning habitat and the low density of potential spawning fish.

3. Sensitive

a. Flannel Mouth Sucker (*Catostomus latipinnis*)

Description and Life Requisites

The flannelmouth sucker is characteristic of large, strong flowing streams of the Colorado River basin, and like other "big-river fishes" it is greatly reduced in range (Minckley 1973). Flannelmouth suckers have fine scales, a slim body, large fins and a ventral mouth with prominent well-developed fleshy, thick lips. The fish is reported to reach 30 inches in length and be a strong swimmer. Breeding habits and spawning site descriptions are not known. This species hybridizes with the razorback sucker. Therefore, they must utilize similar spawning habitat at similar times. However, the fish is also reported to hybridize with mountain suckers in the Virgin River (LaRivers 1962). The fish is herbivorous and feeds on plant materials, algae and seeds (Sigler and Miller, 1963).

Distribution and Abundance

The lower Colorado River supported a population of this species, as it was recorded from the Yuma, Arizona, area in the late 1800s (Minckley 1979). The fish has been collected from the Virgin River in southern Utah and from the Gila River subbasin in central Arizona (Minckley 1973). A single specimen was taken in a gill net in Lake Mohave in 1954 (Jonez and Sumner).

While the native population has apparently been extirpated, 600 flannelmouth suckers were captured in the Colorado River below Glen Canyon Dam at the mouth of the Paria River in 1976. These fish were stocked into the lower Colorado River below Davis Dam to feed on the abundant black-fly, a local pest. The fish have survived and have spawned and recruited into adulthood. Flannelmouth suckers from this stock are captured during annual surveys below Davis Dam by AGFD personnel (Tom Liles, pers. comm.) and NDOW personnel (Mike Burrell, pers. comm.)

Effect Analysis

The routine operation and maintenance activities described in this document will not effect the flannelmouth sucker.

b. California floater (*Anodonta californiensis*)

Description and Life Requisites

The life cycle of mussels, or bivalves, includes both larval and adult life stages. In the superfamily Unionaceae, the larval stage (called the glochidium) is parasitic, and larvae in the subfamily Anodontia parasitize only fish (Thorp and Covich 1991). The larvae attach to fish hosts with a pair of hooks that project from the inner margins of the shell. The host fish forms a cyst around the glochidium, and the encysted glochidium remains on its fish host for 6 to 160 days until it reaches a size of 50-400 micrometers (μm) and releases itself from the host. In *Anodonta* spp., the glochidia attach only to the fins of their hosts (Bequart and Miller 1973). Unionaceae bivalves rely on their fish hosts for dispersal.

Upon its release from the host, the glochidium metamorphoses into the adult bivalve. The adult stage is stationary and feeds by filtering suspended algae, bacteria, and detritus from water flowing across its gills (Thorp and Covich 1991). Adult clams in the Unionaceae reach reproductive maturity after 6 to 12 years and have a lifespan of up to 100 years, depending upon the species. *Anodonta* bivalves reproduce by the male releasing sperm into the water. The sperm is then taken up by the female as it inhales water and fertilizes eggs located in the gill. After the eggs complete development, the glochidia are released live into the water. Although Unionaceae bivalves produce 200,000 to 17,000,000 young per adult female per year, the survivorship to adult stage is extremely low due to the requirements of locating and successfully parasitizing a fish host.

Distribution and Abundance

A. californiensis currently occurs in Oregon, California, Utah, and Arizona (Bequart and Miller 1973). In Utah, the species is apparently common enough to be used in research bioassays; Hovich and Linker (1993) collected*A. californiensis* "in western Utah" and used the specimens to study carbohydrate synthesis.

In Arizona, the species appears to be on the brink of extinction. *A. californiensis* was first described in 1852 by J.L LeConte from specimens collected from the lower Colorado River near Yuma, Arizona (Bequart and Miller 1973). The species was likely collected near Fort Yuma, because LeConte was serving at the time as Army Surgeon at the fort. The only other collection of *A. californiensis* from the lower Colorado River was in 1894, when E.A. Mearns collected specimens at "Station 68 [Mearns's designation] near Boundary Monument No. 204 ... from a laguna of Colorado Riv in Yuma Co." (Bequart and Miller 1973). Although fossil evidence suggests that *A. californiensis* was once common in Arizona as recently as the late 1800s, the species has only been collected this century during the 1950s from the Black River and Little Colorado River in Apache County and from the Little Colorado River in Navajo County (Bequart and Miller 1973).

Effect Analysis

Routine operation and maintenance activities will not affect this species.

A. californiensis is believed to be extinct on the lower Colorado River, because it has not been collected from the river since 1894. The reason for the species disappearance in the river is not clear. Native Unionaceae bivalves are particularly vulnerable to extinction, because their long life spans, delayed maturity, high larval mortality, and poor dispersal capability prevent them from responding quickly to environmental changes (Thorp and Covich 1991). Bequart and Miller (1973) hypothesize that populations of *A. californiensis* have declined due to declining populations of their host fish. There is no documentation of what the host fish was or is for this species.

E. Mexico Species

FWS, in its memorandum dated March 19, 1996, recommended that the effects analysis of this document also address five listed species that are endemic or have a portion of their range in Mexico. These species were the Yuma clapper rail, southwestern willow flycatcher, desert pupfish, totoaba, and vaquita (Gulf harbor porpoise). The biology and potential effects of the first two species have been discussed previously. The latter three species are discussed below.

The reduction in Colorado River flows below the SIB has had an affect on the historical ecosystem of the delta. However, these reductions have been instituted through an international treaty, and the diversion and use of such treaty water is solely at Mexico's discretion. Except for major flood periods as experienced on the Colorado River in the mid-1980s, little water reaches the delta and the upper Gulf. It is not within Reclamation's discretionary authority on the lower Colorado River to augment or make unilateral adjustments to water deliveries to the international border.

Reclamation provided the NMFS a copy of the previous draft (March 1996) of this assessment and will also provide them an official copy of this final BA. The NMFS provided comments on the draft BA via letter dated June 28, 1996. In its letter, NMFS determined that lower Colorado River operations are not likely to adversely affect the vaquita and four listed sea turtles (i.e., green sea turtle, leatherback sea turtle, loggerhead sea turtle, and olive ridley sea turtle). NMFS also requested additional analysis of the biology and factors affecting the endangered totoaba along with a discussion of the United States discretion regarding Mexico's treaty waters.

1. Desert pupfish (*Cyprinodon macularius*)

Description and Life Requisites

The desert pupfish is a small killifish with a smoothly rounded body shape. Adults generally range from 2-3 inches in length. Males are smaller than females and during spawning the males are blue on the head and sides and have yellow edged fins. Most adults have narrow, dark, vertical bars on their sides. The species was described in 1853 from specimens collected in San Pedro River, Arizona. There are two recognized subspecies and possibly a third form (yet to be described). The nominal subspecies, *Cyprinodon macularius macularius*, occurs in both the Salton Sea area of southern California and the Colorado River delta area in Mexico and is the species of concern, herein. The other subspecies is *C.m. eremus* and is endemic to Quitobaquito Spring, Arizona.

The desert pupfish was listed as an endangered species on March 31, 1986. Critical habitat for the species was designated at the time of listing and included the Quitobaquito Spring which is in Organ Pipe Cactus National Monument, and San Felipe Creek along with its two tributaries Carrizo Wash and Fish Creek Wash in southern California. All of the former and parts of the latter were in Federal ownership at the time of listing. Reclamation purchased the remaining private holdings along San Felipe Creek and its tributary washes and turned them over to CFG in 1991. All of the designated critical habitat is now under State or Federal ownership.

Desert pupfish are adapted to harsh desert environments and are extremely hardy. They routinely occupy water of too poor quality for other fishes, most notably too warm and too salty. They can tolerate temperatures in excess of 110° F; oxygen levels as low as 0.1 ppm; and salinity nearly twice that of sea water (over 70 parts per thousand [ppt]). In addition to their absolute tolerance of these parameters, they are able to adjust and tolerate rapid, extreme changes to these same parameters (Marsh and Sada 1993).

The fish have a short life span, usually only 2 years, but they mature rapidly and can reproduce as many as three times during the year.

Distribution and Abundance

Desert pupfish inhabit desert springs, small streams, creeks, marshes and margins of larger bodies of water. The fish usually inhabit very shallow water, often too shallow for other fishes. Present distribution of the subspecies *C. m. macularius* includes natural populations in at least 12 locations in the United States and Mexico, as well as over 20 transplanted populations.

One of the natural populations in Mexico is in the Cienega, a 100,000 acre bowl on the Colorado River delta 60 miles south of the U.S./Mexico border. The area is about 90 percent unvegetated salt flats with a number of small marsh complexes along the eastern edge of the bowl where it abuts an escarpment. The area is disconnected from both the Colorado River and the Gulf (Sea of Cortez), however extreme high tides result in the lower half of the bowl becoming inundated to a level of one foot or less of salt water from the gulf. The marsh areas on the east side are small and are spring fed. The largest marsh complex is on the northeast side where two agricultural drains provide relatively fresh water inflows. The desert pupfish occur in a number of these marsh complexes.

Reclamation biologists discovered this population of desert pupfish in 1974 during preproject investigations for a feature of the Colorado River Basin Salinity Control Project. At that time, the Cienega was being fed by agricultural return flows from the Riito Drain in Mexico which provided about 35 cfs flow. The project feature being investigated was construction of a bypass canal for drain water from WMIDD.

Desert pupfish were found in the marsh along with mosquitofish, sailfin mollies, carp and red shiners. The bypass canal was completed in 1978 and provided a steady flow of over 150 cfs to the marsh. Based upon aerial surveys, the added inflow caused the marsh to grow from an estimated 300 acres of vegetated area in 1974 to roughly 10,000 acres in 1985. Recent aerial surveys show that while the inflows have continued, the marsh has not continued to grow in size. Desert pupfish continue to exist in the marsh. The fish tend to inhabit the shallow edges of the marsh in vegetated areas.

Desert pupfish from the Cienega were transported to Dexter National Fish Hatchery during May 1983, and many of the transplanted populations in the United States are of this subspecies and stem from this initial transplant.

Effects Analysis

During preproject investigations in 1974 to 1976, Reclamation biologists observed desert pupfish in the Cienega. Measurements of water quality at that time revealed salinity ranging from 6 ppt inthe irrigation drain inflow to over 80 ppt at the edge of the salt flats. Bypass canal water, which began flowing into the Cienega in 1978, was 3.2 ppt and resulted in rapid expansion of the vegetated areas of the Cienega. Salinity measurements made in 1994 were similar to those made in 1974 and ranged from 4 - 80 ppt. Operation of the YDP at one-third capacity would reduce the flow of drain water coming into the marsh, via the main outlet drain, from 135,000 acre-feet to 108,800 acre-feet. This action may raise the lower end of the salinity range from 4 ppt to 6 ppt which may affect some of the nonnative fish in the marsh and would possibly be a net benefit to the desert pupfish. Since aerial expansion of the marsh has not continued, it is unlikely that available habitat for desert pupfish would change. We conclude, therefore, that operation of the YDP at one-third capacity would not effect desert pupfish in the Cienega.

2. Vaquita (*Phocoena sinus*)

Description and Life Requisites

The vaquita is a small porpoise and is widely believed to be the most endangered marine cetacean in the world (Klinowska 1991; Taylor and Gerrodette 1993). It is also the only endemic species of marine mammal from the Gulf.

The vaquita is very similar in external morphology to the harbor porpoise (*Phocoena phocoena*). Based on a very small sample and a maximum recorded total length of about 5 feet, the vaquita may be the smallest of all the delphinoids (Brownell et al. 1987). The pectoral fins are larger and the dorsal fin is higher proportionally to the body length than in any other extant porpoise species (Brownell et al. 1987).

The coloration of adult vaquitas is unique. On the dorsal portion, the color is dark gray, the sides are pale gray, and the ventral surface is white with some pale-gray elongated spots. The porpoise has a large, dark eye spot and lip patches that contrast with the gray background (Ramirez 1993).

Little is known about the reproductive biology of the species. It has been suggested that calving occurs in the spring and mating in late spring or soon thereafter (Vidal 1990). Food habits are also practically unknown; Fitch and Brownell (1968) reported small fish such as grunt (*Orthopristis reddingi*) and croaker (*Bairdiella icistia*) from stomach contents and Brownell (1982) also reported squid.

Distribution and Abundance

The geographic distribution of the vaquita appears to be confined to the upper Gulf, representing the most restricted range for any cetacean species (Ramirez 1993). Sightings outside of this region (south of 30° 45' N latitude) may represent occasional departures by some individuals from the center of distribution (Silber and Norris 1991) or temporary extensions in distribution due to climatic changes (Vidal 1990). The region south of Puerto Penasco, Sonora, Mexico, remains insufficiently monitored to further increase the accuracy of population estimates and to establish the southern limit of the geographic range of the species (Ramirez 1993).

The range of the vaquita overlaps that of the endangered totoaba, to which it may be linked ecologically (Ramirez 1993).

A number of factors make the vaquita an extremely difficult species to survey; habitat characteristics such as turbid water, fraction of the time spent at the surface, elusive behavior, and its erratic surfacing mode (Ramirez 1993). Despite these difficulties, and biases in collection of survey data, it is clear that the species is rare (between 224 to 855 individuals) (Barlow et al. in press). Barlow et al. (in press) expect that with current levels of mortality, a low reproductive potential, and a low population estimate in 1993 of 224, the species will continue a decreasing trend in abundance into the future.

Effect Analysis

Any effect analysis of present-day river operations on the vaquita is severely hampered by the lack of data on the biology of the species, ecological interactions and effects of pre-dam freshwater flows into a marine environment, and the impacts the subsequent reduction in flows and sediment had on the flora and fauna of the Gulf.

Ramirez (1993) identified three actual and potential impacts to the vaquita: incidental mortality caused by fishery activities, reduced Colorado River flows into the gulf, and pollution from various sources associated with Colorado River flows into the gulf.

Vaquita have been killed in gillnets set for totoaba which has been a commercially important fishery in the gulf. Although the totoaba fishery was banned in 1975, it has continued illegally, further endangering both the totoaba and the vaquita. Vidal et al. (1991) estimated that a minimum of 95 vaquitas died in gillnets between 1985 and 1990, for an average mortality of 15.3 animals per year. This incidental loss can not be sustained by the population (Ramirez 1993). Shrimp trawling may also impact the vaquita through the direct depletion of an existing food source (shrimp) and by disrupting the benthos and associated foodweb.

Reduced flow into the upper gulf may have contributed to an alteration of the vaquita's habitat (Brownell 1982, Ramirez 1993). This reduction in freshwater flow and sediments caused by construction of Hoover Dam and other facilities may have caused alterations in food webs and biological diversity. This is, however, a hypothesis with little supporting data. In fact, some evidence suggests that the Colorado River delta behaves as a very fertile coastal lagoon, supporting abundant populations of crustaceans and mollusks (Alvarez-Borrego 1992), and substantial numbers of bottlenose dolphins utilize the delta (Silber 1990, Ramirez 1993).

Concern has been raised about the concentration of organochlorine pollutants and fertilizers in the agricultural return flows that make their way into the Colorado River and eventually into the gulf. Some of these pollutants have made it into the Gulf, but samples taken from vaquita suggest that organochlorine and heavy metal concentrations are lower than in marine mammals elsewhere (Ramirez 1993).

According to Rojas-Bracho and Urban-Ramirez (n.d.) the data suggest that pollution and reduced or null freshwater flow from the Colorado River are not significant factors in threatening the immediate survival of the vaquita, whereas commercial fishing might be the most critical factor affecting continued survival.

Until further studies and data prove otherwise, Reclamation's routine operation and maintenance activities along the lower Colorado River will not affect the vaquita.

3. Totoaba (*Totoaba macdonaldi*)

The totoaba is a fish endemic to the Gulf, Mexico. On May 21, 1979, the totoaba was listed as endangered pursuant to the Endangered Species Act (44 FR 99). This international species was included in this assessment at the suggestion of the FWS and a number of public stakeholders.

Description and Life Requisites

Totoaba are large schooling fish that undertake a seasonal migration within the Gulf and may live to 25 years of age (Cisneros-Mata et al. 1995). Totoaba are the largest of the sciaenid fish, with a maximum reported weight of over 100 kg and a length of over 2 meters (Flanagan and Hendrickson 1976). Adults spawn in the shallow waters of the Colorado River delta in the upper Gulf where they remain for several weeks before migrating south. Juveniles are thought to emigrate south after spending 2 years in the upper Gulf, which is considered their nursery ground (Flanagan and Hendrickson 1976).

Juvenile fish eat small benthic organisms, mainly crabs and fish, amphipods, and shrimp; adults eat larger more pelagic items, such as sardines and adult crabs (Flanagan and Hendrickson 1976, Cisneros-Mata et al. 1995). Many aspects of the biology and ecology of this species are unknown.

Distribution and Abundance

The totoaba is thought to have ranged from the mouth of the Colorado River to Bahia Concepcion on the west coast of the Gulf and to the mouth of the El Fuerte River in the east (Jordan and Everman 1896 cited in Berdegue 1955). Historically, millions of totoaba migrated north in the spring to spawn at the mouth of the Colorado River (Gause 1969).

The first commercial harvesting of totoaba began in the early 1890s and by 1942, annual catches peaked at 2.3 million kg. In 1975, the catch had declined to 59,142 kg (Lagomarsino 1991). Beginning as early as 1940, the Mexican government imposed restrictions on the commercial fishery for totoaba, and in 1975, the government designated totoaba as endangered and declared an indefinite prohibition on all types of commercial and recreational fishing (Flanagan and Hendrickson 1976).

Despite conservation efforts the totoaba population has continued to decline. Cisneros-Mata et al. (1995) review a variety of human activities that may have affected the totoaba population: prerecruits (egg to 1 year) may have been affected by decreased fresh-water input from the Colorado River, juveniles (1 to 2 years of age) by shrimp harvesting, pre-adults (3 to 5 years) by sport fisherman, and adults (6 years of age and older) by commercial fishing and poaching.

Despite the closure of the fishery, illegal exploitation continued. It is believed that the incidental catch of juvenile totoaba in the shrimp trawling fishery is the principal factor effecting the recovery of the species (Barrera 1990). Much of the illegal gillnetting for totoaba occurs during the spawning migration. As a result, gravid fish are being fished out of the population.

Effect Analysis

Modification of the flows and water quality of the Colorado River are commonly identified as primary factors contributing to the decline of the totoaba population. Fifty percent of the freshwater flow into the Gulf was from the Colorado River (Silber 1990). Since the delta is no longer subject to annual flooding, totoaba spawning and nursery grounds are considered to have been reduced (Lagomarsino 1991). It is speculated that the salinity gradient formed by spring-flood waters mixing with the saline water of the upper Gulf may have provided an environmental cue for migrating adults to locate their spawning grounds. Loss of the gradient due to the hyper salinity of irrigation return flows into the Gulf may adversely influence existing spawning migrations (Lagomarsino 1991). Cisneros-Mata et al. (1995) also believe that historical Colorado River flows probably had a two-fold effect in the upper Gulf by enhancing habitat for prerecruits and juvenile totoaba by increasing the carrying capacity (addition of nutrients and volume) and regulating water temperatures and salinity.

Cisneros-Mata et al. (1995) indicate that the negative impact on totoaba "due to decreased flow from the Colorado River may be questionable because the claimed effects would have caused extinction of totoaba over 40 years time." Lagomarsino (1991) believes that the loss of adequate spawning and nursery ground areas due to decreased Colorado River flows has probably led to the decline in the growth rate of the population. She also acknowledges that the unregulated taking of juvenile and adult totoaba may seriously influence the recovery of this species. Flanagan and Hendrickson (1976) concluded that over fishing explained the decline of the totoaba population better than habitat alteration.

It is clear that protection of the adults is necessary for recovery of the stock. However, because of a potentially reduced carrying capacity and growth rate, the population of totoaba may never reach historical proportions (Cisneros-Mata et al. 1995).

The regulation of the Colorado River through construction and operation of river facilities and an international treaty probably have had an impact on the spawning habitat of totoaba. The current status of the totoaba population is nonexistent and general biological and ecological data is very sparse, especially on the salinity and temperature tolerance of early life stages. However, we believe that until this information becomes available, it is prudent to conclude that the non-discretionary water management on the river may affect the totoaba through possible degradation of spawning grounds. Reversal of this trend (if so documented) will be critical to the survival of the species, but unless there is containment and/or elimination of illegal and incidental harvesting, the species will continue to be listed as endangered despite any efforts to re-create past flows.

In its letter of June 28, 1996, the NMFS concluded that Reclamation may have limited discretion in taking actions necessary to remedy potential habitat problems; and if that were true, it is possible that a section 7 consultation may not be needed on the totoaba. However, before it could render a determination, NMFS required additional information on four issues. This information is provided in the following paragraphs.

The United States ability to reverse conditions in the Colorado River delta is virtually nonexistent. The reasons for this involve an international treaty and U.S. restrictions. The waters of the Colorado, once delivered to Mexico, as agreed upon in the Mexican Water Treaty of 1944, are the exclusive property of the sovereign nation of Mexico. Further, this treaty contains no provisions requiring Mexico to provide water for environmental protection nor any requirements relating to Mexico's use of that water. Finally, a Supreme Court decree in 1964 enjoined Reclamation from releasing water to Mexico in excess of the quantity identified in the 1944 treaty except for flood control purposes.

Acting through IBWC, Reclamation and its counterpart in Mexico have developed a forum for the exchange of technical information. Any efforts to discuss releasing flows into the upper Gulf with the Mexican government would be subject to the protocol set forth by IBWC and the Mexican Water Treaty. A copy of this biological assessment will be provided to the U.S. Section of the IBWC, who in turn will provide it to the Mexican Section of the IBWC (IBWC letter dated May 21, 1996).

It is Reclamation's conclusion that since the United States has no authority (or discretion) regarding the flow of water to the Colorado River delta, a section 7 consultation on the potential effects of its lower Colorado River operations and maintenance on the endangered totoaba is not required.

F. Summary of Effect Analyses

The potential effects of lower Colorado River operation and maintenance activities, as projected over the next 5 years, on the species under consideration are summarized in Table 16.

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GLOSSARY OF TERMS AND ACRONYMS

Pursuant to the Biological Assessment

Acronyms:

AGC	Automatic Generation Control	LMNRA	Lake Mead National Recreation Area
AGFD	Arizona Game and Fish Department	maf	million acre feet
AOP	Annual Operating Plan	Mgal/day	million gallons per day
ASU	Arizona State University	µm	micrometer
BA	Biological Assessment	MSCP	Multi-Species Conservation Program
BIA	Bureau of Indian Affairs	msl	mean sea level
BLM	Bureau of Land Management	MWD	The Metropolitan Water District of Southern California
BOR	Bureau of Reclamation	MW	megawatt
CAP	Central Arizona Project	NEPA	National Environmental Policy Act
CAWCD	Central Arizona Water Conservation District	NDOW	Nevada Division of Wildlife
CFG	California Department of Fish and Game	NF	National Forest
CFR	Code of Federal Regulations	NFWG	Native Fish Work Group
cfs	cubic feet per second	NIB	Northerly International Boundary
Cienega	Cienega de Santa Clara	NMFS	National Marine Fisheries Service
COE	Corps of Engineers	NPS	National Park Service
Corps	Corps of Engineers	OM&R	operation, maintenance, and replacement
CRIT	Colorado River Indian Tribes	PVID	Palo Verde Irrigation District
CROD	contract rates of delivery	ppm	parts per million
CVWD	Coachella Valley Water District	Reclamation	Bureau of Reclamation
dB	decibel	RPAs	Reasonable and Prudent Alternatives
EIS	Environmental Impact Statement	RPMs	Reasonable and Prudent Measures
ESA	Endangered Species Act of 1973, as amended	Secretary	Secretary of the Interior
FEMA	Federal Emergency Management Agency	SIB	Southerly International Boundary
FHWA	Federal Highway Administration	USBR	Bureau of Reclamation
FR	*Federal Register*	USDA	United States Department of Agriculture
FWS	Fish and Wildlife Service	WAPA	Western Area Power Administration
Gulf	Gulf of California	WBNFH	Willow Beach National Fish Hatchery
HAVFISH	Lake Havasu Fishery Improvement Project	Western	Western Area Power Administration
IBWC	International Boundary and Water Commission	WMIDD	Wellton-Mohawk Irrigation and Drainage District
IID	Imperial Irrigation District	WSCC	Western Systems Coordination Council
JOA	Joint Operating Agreement	YAO	Yuma Area Office
kW	kilowatt	YDP	Yuma Desalting Plant

Terms:

Irrigation use: the use of mainstream water for the commercial production of agricultural crops or livestock, including use of water for other purposes incidental thereto, on tracts of arable land operated in units of more than 5 acres.

Annual Operating Plan: the projected annual plan of operation prepared in accordance with the *Criteria for Coordinated Long-Range Operation of Colorado River Reservoirs* pursuant to section 602 of the Colorado River Basin Project Act of September 30, 1968, and adopted by the Secretary for operating the reservoirs of the Seedskadee, Colorado River Storage, Boulder Canyon, and Parker-Davis Projects during the 12-month period from October 1 through the following September 30.

Apportionment: both 1) the total amount of Colorado River water available for beneficial use within a calendar year in the lower Colorado River basin as established by the Colorado River Compact and 2) the division of the amount of Colorado River water available to the lower Colorado River basin among the lower basin States as established by the Boulder Canyon Project Act and confirmed by the Court decree. Such apportionment will vary depending upon whether the Secretary, in accordance with the Supreme Court Decree and the criteria for the Annual Operating Plan in any 1 year, has declared a normal, shortage, or surplus condition for that year. For a normal water year, the lower basin is entitled to receive 7.5 maf.

Basic apportionment: the Colorado River water apportioned to each lower basin State when sufficient water is available for release, as determined by the Secretary, to satisfy 7.5 maf of annual consumptive use in the lower basin. The basic annual apportionment for a normal year is 2.8 maf of consumptive use for Arizona; 4.4 maf of consumptive use for California; and 0.3 maf of consumptive use for Nevada.

Beneficial use: all uses of Colorado River water which are: 1) for non-Federal entitlement holders, consistent with relevant State law, or as otherwise permitted by the Secretary; 2) for non-Indian Federal entitlement holders, consistent with decreed entitlements, applicable contracts, administrative reservations of water entitlements, or the purposes for which the reservations were created; and 3) for Indian Federal entitlement holders, consistent with relevant Federal and Tribal laws.

Colorado River water: the waters of the Colorado River and the waters of the hydraulically connected aquifers which originated from the Colorado River or would be replaced by water from the Colorado River upon withdrawal.

Consumptive use: 1) diversions from the Colorado River, including diversions by underground pumping, less such return flow thereto as is available for consumptive use in the United States or in satisfaction of the Mexican treaty obligation, and 2) evaporative or other losses from the Colorado River resulting from actions taken subsequent to March 9, 1964 (the date of the Supreme Court Decree in **Arizona v. California, et al.**).

Contractor: any person or entity in Arizona, California, or Nevada who has a valid contract or agreement with the United States for the delivery of Colorado River water or power.

Decree: of the Supreme Court of the United States in the case of **Arizona v. California et al.**, entered March 9, 1964 (376 U.S. 340), as supplemented or amended, which establishes certain decreed water rights within the lower Colorado River basin and recognizes the authority of the Secretary to allocate, contract for, and administer water entitlements in the lower basin.

Diversions: Colorado River water withdrawn from the mainstream, including water diverted from reservoirs or drawn from the mainstream by underground pumping.

Domestic use: the use of Colorado River water for household, stock, municipal, mining, milling, industrial, and other like purposes, but excludes the release of water solely for generation of hydroelectric power.

Entitlement: an authorization to beneficially use Colorado River water pursuant to: 1) a decreed right, 2) a contract with the United States through the Secretary, or 3) a Secretarial reservation of water.

Federal entitlement holder: a Federal agency or Indian tribe identified in article II(D) of the Decree or otherwise recognized by the Secretary as having an entitlement for the beneficial use of Colorado River water.

Interdependent: those actions that have no independent utility apart from the action under consideration (50 CFR 402.02).

Interrelated: those actions that are part of a larger action and depend on the larger action for their justification (50 CFR 402.02).

Lee Ferry, Lees Ferry, or Lee's Ferry: The point defined in the 1922 Compact which divides the upper and lower basins and is located within the mainstream of the Colorado River 1 mile below the mouth of the Paria River.

Long-Range Operating Criteria: the Criteria for Coordinated Long-Range Operation of Colorado River Reservoirs pursuant to section 602 of the Colorado River Basin Project Act of September 30, 1968.

lower basin States: the States of Arizona, California, and Nevada.

Lower Colorado River basin or **lower basin**: those parts of the States of Arizona, California, Nevada, New Mexico, and Utah within and from which waters naturally drain into the Colorado River below Lees Ferry and also parts of those States located outside the drainage area which are or shall hereafter be beneficially served by waters diverted from the Colorado River below Lees Ferry.

Mainstream or **mainstem**: the main channel of the Colorado River, exclusive of tributaries, downstream from Lees Ferry within the United States, including the areas covered by reservoirs, wetlands, lakes, ponds, and backwaters; and the waters of the hydraulically connected aquifers which originated from the Colorado River or would be replaced by water from the Colorado River upon withdrawal.

Master Schedule: the weekly schedule that shows the estimated daily diversions or releases of water at Imperial Dam: 1) to be delivered for use in the United States, including power generation at Siphon Drop Powerplant and Pilot Knob Powerplant, 2) to be used in the United States, as reasonably required, during such week for river regulation below Imperial Dam, 3) to be delivered to Mexico through the All-American Canal pursuant to the Mexican Treaty, and 4) to be delivered to Mexico, if any, under the Mexican Treaty by means other than through the All-American Canal. The master schedule is prepared each Wednesday for the upcoming week (Monday through Sunday).

Mexican Treaty obligation: the United States obligation under the Mexican Water Treaty, Executive A, Seventy-eighth Congress, second session, a treaty between the United States of America and the United Mexican States, signed at Washington, D.C., on February 3, 1944, relating to the utilization of the waters of the Colorado and Tijuana Rivers and of the Rio Grande River from Fort Quitman, Texas, to the Gulf of Mexico; Executive H, Seventy-eighth Congress, second session, a protocol signed at Washington, D.C., on November 14, 1944, supplementary to the Mexican Water Treaty and obligations associated with Minutes of the IBWC adopted pursuant to said treaty.

Northerly International Boundary: that portion of the boundary between Mexico and the United States that is delineated by the border between Mexico and the State of California that extends westerly from the Colorado River.

Perfected right: a water right acquired in accordance with State law, which right has been exercised by the actual diversion of a specific quantity of water for beneficial use that has been applied to a defined area of land or to definite municipal or industrial works, and includes water rights created by the reservation of mainstream water for the use of Federal establishments under Federal law whether or not the water has been put to beneficial use or used continuously.

Permanent service: the perpetual right to use Colorado River water pursuant to an entitlement, subject to the restrictions or conditions of other relevant law.

PIT Tag: a passive integrated transponder (PIT) tag. Electronic glass sliver containing computer chip and coil of wire used to identify individual fishes. Computer chip has ten-digit alpha-numeric code energized by passing a magnet over tag.

Present perfected right or **PPR**: perfected rights defined by the Decree, existing as of June 25, 1929, the effective date of the Boulder Canyon Project Act. Present perfected rights are listed in the supplemental Court decrees entered January 9, 1979, and April 16, 1984, and in future supplemental decrees by the United States Supreme Court.

Reasonable beneficial use: the diversion, distribution, delivery, and use of Colorado River water for a useful or beneficial purpose in an amount not to exceed that reasonably required for such use or purpose.

Reclamation: the Bureau of Reclamation of the Department of the Interior.

Returns or **return flow**: Colorado River water diverted from the mainstream which flows back to the mainstream either through surface or subsurface means and is available for consumptive use in the United States or in satisfaction of the Mexican treaty obligation.

Riprap: an uncontained rock blanket placed for bankline protection.

Secretarial reserved entitlement: 1) an entitlement set aside for a Federal agency via notice in the *Federal Register*, or 2) an entitlement established in an agreement between Reclamation and another Federal agency.

Secretary: the Secretary of the Interior or a duly authorized representative.

Seven-Party Agreement: the agreement dated August 18, 1931, among the Palo Verde Irrigation District, the Imperial Irrigation District, the Coachella Valley Water District, The Metropolitan Water District of Southern California, the City of Los Angeles, the City of San Diego, and the County of San Diego.

Southerly International Boundary: that portion of the boundary between the United States and Mexico that is delineated by the border between Mexico and the State of Arizona that extends southeasterly from the Colorado River.

Subsurface water: water beneath the land surface.

Surface water: water at or above the land surface.

Surplus apportionment: the Colorado River water apportioned to the lower Colorado River basin in any 1 year when the Secretary determines as part of the AOP surplus sufficient water is available in excess of 7.5 maf of annual consumptive use in the lower basin. Article II(B)(2) of the Decree provides that water available for annual consumptive use in excess of 7.5 maf shall be apportioned as follows: 50 percent for use in California, 46 percent for use in Arizona, and 4 percent for use in Nevada.

Tributaries: all stream systems the waters of which naturally drain into the mainstream of the Colorado River below Lees Ferry.

Unauthorized use: any diversion or consumptive use of Colorado River water without an entitlement or not in conformance with an entitlement.

Unused apportionment: Colorado River water within a lower basin State's basic or surplus apportionment, or both, which is not put to beneficial consumptive use in that year within that State.

Waste: a nonbeneficial use of water such as the diversion of an extravagant quantity, use of an exceedingly inefficient delivery system, or other such practice which results in a loss of water from the system which could have been put to beneficial use.

Water user: any person or entity diverting and using Colorado River water.

APPENDIX A

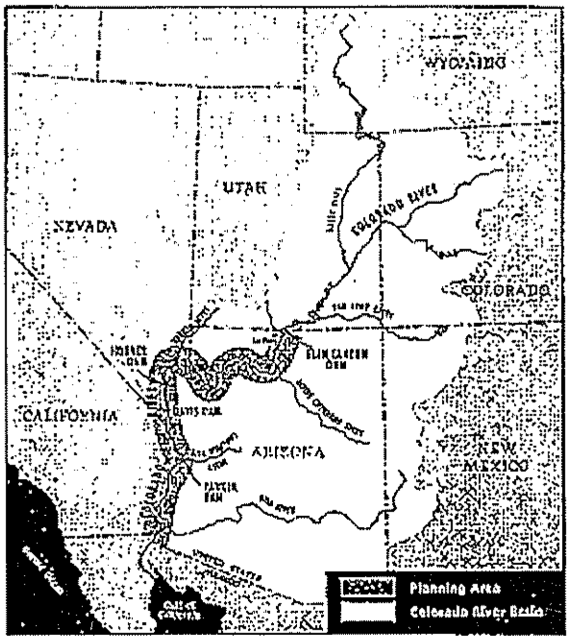
Lower Colorado River

Multi-Species Conservation Program

It's long been said that the Colorado River is the lifeblood of the West. Today, the Colorado River supplies vital water and power resources for more than 20 million people in Arizona, California and Nevada.

Recently, concerns have been raised about the reliability of these water and power resources following the U.S. Fish and Wildlife Service's 1994 designation of critical habitat for four endangered fish species in the Colorado River Basin.

In response, representatives of the three states, along with the various water and power agencies along the lower Colorado, have formed a regional partnership, which is developing a first-of-its kind multi-species conservation program aimed at protecting sensitive, threatened and endangered species of fish, wildlife and their habitat.



Map showing planning area

Description:

▼ The multi-species conservation program will work toward the recovery of listed species through habitat and species conservation, and attempt to reduce the likelihood of additional species listings under the Endangered Species Act.

▼ The proposed long-term program also will accommodate current water diversions and power production and optimize opportunities for future water and power development.

▼ Planned to be implemented over a 50-year period, the comprehensive program will address future federal agency consultation needs under the Endangered Species Act's Section 7, and non-federal agency needs for endangered species incidental take authorization approval under the Act's Section 10.

▼ Over a three-year planning period for the development of a comprehensive program, interim conservation measures will be implemented to address the immediate critical needs for certain endangered species. Interim measures to benefit the endangered razorback sucker and bonytail chub are proposed for the first year.

Location:

The program covers the mainstem of the lower Colorado River from below Glen Canyon Dam to the Southerly International Boundary with Mexico. The program area includes the 100-year flood plain and reservoir full pool elevations.

Biological scope:

More than 100 federal or state-listed, candidate, and sensitive species and their associated habitats, ranging from aquatic, wetland and riparian habitats, to upland areas will be addressed.

The program will address the biological needs of mammals, birds, fish, amphibians and reptiles, as well as invertebrates and plants.

Stakeholders:

The program involves a broad-based state/federal/tribal/private regional partnership, which includes water, hydroelectric power and wildlife management agencies in Arizona, California and Nevada. The stakeholders include:

U.S. Department of the Interior:
- Fish and Wildlife Service
- Bureau of Reclamation
- National Park Service
- Bureau of Land Management
- Bureau of Indian Affairs

Arizona:
- Department of Water Resources
- Department of Game and Fish

California:
- Colorado River Board of California
- Department of Fish and Game

Nevada:
- Colorado River Commission of Nevada
- Nevada Division of Wildlife

Lower Colorado River Basin Indian Tribes

Various water and hydroelectric power resource management agencies within the three Lower Basin states.

The program also is seeking the participation by conservation groups. American Rivers, the Environmental Defense Fund, the Defenders of Wildlife, the Grand Canyon Trust and The Nature Conservancy have participated informally in the program's early planning efforts.

Program cost:

Projected at about $4.5 million over three years for planning needs and implementation of the interim conservation measures. Equitable federal/non-federal cost-sharing is being pursued.

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APPENDIX B

CONSULTATION AGREEMENT
SECTION 7 CONSULTATION ON LOWER COLORADO RIVER OPERATIONS
BETWEEN BUREAU OF RECLAMATION AND FISH & WILDLIFE SERVICE

PURPOSE: The intent of this agreement is to establish an approach that will accommodate the requests and interests of stakeholders to have access to information and to submit comments during the process of consultation on Lower Colorado River operations. At the same time it is the intent of the Bureau of Reclamation (Reclamation) and the Fish and Wildlife Service (FWS) to ensure that the consultation is completed in a timely fashion and to comply with all procedures and requirements of the Endangered Species Act.

It is important to recognize that the process described in this agreement is specific to this consultation and is not intended to extend regulations related to any National Environmental Policy Act or Rulemaking process. The target dates identified for each step of the process will be followed closely. The intent of this agreement is to maintain the process as described below; however, it is possible that this process may have to be modified or even abandoned if circumstances change (e.g., litigation is filed, or new proposals are submitted).

Reclamation's proposed action in this consultation is its operation and maintenance of its facilities on the Lower Colorado River for a period of five years, or until a long-term conservation program is developed, whichever comes first. The geographic area addressed in this consultation is within the Lower Colorado River basin and is limited to the main stem reach of the river (i.e., from the upper end of Lake Mead at Pierce Ferry to the southerly international boundary with the Republic of Mexico). The environmental baseline will include existing conditions as described in 50 C.F.R. § 402.02.

STEP 1 - SUBMISSION OF DRAFT BIOLOGICAL ASSESSMENT (BA) - INITIATION OF FORMAL CONSULTATION - DRAFT BIOLOGICAL ASSESSMENT PROVIDED TO STAKEHOLDERS. (March 31, 1996). Reclamation will transmit the Draft BA to FWS and submit a letter requesting initiation of formal consultation. Reclamation will also transmit the Draft BA to all stakeholders and parties that have requested an opportunity to participate (e.g., environmental groups, States, and Tribes).

STEP 2 - DRAFT BIOLOGICAL ASSESSMENT AVAILABLE FOR PUBLIC COMMENT. (Estimated date of close of comment period: May 15, 1996). As soon as practical, but no later than April 30, 1996, Reclamation will publish in the Federal Register a notice of availability (listing locations where the public may review the Draft BA) and also issue a news release on the notice. The notice will provide that the Draft BA will be made available for comment for a 30 day period. Reclamation will coordinate this review.

STEP 3 - RESPONSE TO COMMENTS ON BIOLOGICAL ASSESSMENT. (Estimated date: June 30, 1996). Reclamation will receive comments, and within 45 days of the close of the public comment period specified in "Step 2", Reclamation will decide on any change or modification to be made to the Draft BA, and transmit this revised BA to the FWS, along with a formal request that the FWS' review under 50 C.F.R. § 402.14(c) begin. Reclamation will consider and respond to comments that relate to scope or technical matters of operations during the 5-year (or shorter) period.

STEP 4 - FWS DEVELOPS AND PROVIDES DRAFT BIOLOGICAL OPINION (BO) TO RECLAMATION. (Estimated date: November 15, 1996). FWS will have up to 135 days to provide Reclamation with the Draft BO.

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STEP 5 - REQUEST OF EXTENSION OF TIME FOR PUBLIC COMMENT ON DRAFT BIOLOGICAL OPINION. (Estimated date: November 30, 1996). Reclamation will request a 120 day extension to allow for public review and comment of the Draft BO. Reclamation will publish a notice in the Federal Register and issue a news release announcing the availability of the Draft BO for comment.

STEP 6 - PUBLIC COMMENT ON DRAFT BIOLOGICAL OPINION. (Estimated date for close of comment period: January 15, 1997). The Draft BO will be made available for comment for 45 days, with directions that comments must be submitted to Reclamation. Reclamation will consider comments pertaining to any errors of fact in the biological data or the proposed action and whether (1) any proposed RPA's and/or RPM's avoid the likelihood of jeopardy and adverse modification of critical habitat and/or reduce incidental take, (2) any proposed RPA's and/or RPM's can be implemented in a manner consistent with the intended purpose of the action, (3) any proposed RPA's and/or RPM's can be implemented in a manner consistent with the scope of the agency's legal authority and jurisdiction, and (4) any proposed RPA's and/or RPM's are economically and technologically feasible.

STEP 7 - RESPONSE TO COMMENT ON DRAFT BIOLOGICAL OPINION. (Estimated date: March 1, 1997). Reclamation will review comments on the Draft BO and decide which constitute new or significant information. It will be Reclamation's responsibility to decide if comments are relevant to consultation, in terms of the action, findings, and recommendations in the Draft BO, and to forward to FWS any amendments to the proposed action and/or requests for changes in RPA's and/or RPM's. Reclamation will respond to letters of comment received on the Draft BO.

STEP 8 - FWS PROVIDES FINAL BIOLOGICAL OPINION TO RECLAMATION. (Estimated date: April 15, 1997). FWS will consider Reclamation's comments and requests in developing a final BO.

STEP 9 - RECLAMATION'S RESPONSE TO THE FINAL BIOLOGICAL OPINION. (Estimated date: May 15, 1997). . A letter will be sent by Reclamation to the FWS which indicates its plans in light of the Final BO.

STEP 10 - PUBLIC COMMENTS AND THE LONG-TERM CONSERVATION PROGRAM. All comments submitted by the public for the Draft BA and the Draft BO will be considered during the scoping process for development of the Lower Colorado River Multi-species Conservation Program.

William E. Rinne 3-29-96

ACTING Regional Director — Date
Bureau of Reclamation

[signature] 3/29/96

Regional Director — Date
U.S. Fish and Wildlife Service

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APPENDIX C - RIVER WORK AND MAINTENANCE

Introduction and Past History

Prior to construction of flood control and storage dams on the Colorado River, the lower river from the present site of Hoover Dam to the Gulf was typical of a river carrying a heavy sediment load over an alluvial bed. Before the dams, the river was actively building up the alluvial valleys by repeated inundation when the spring snowmelt flowed from the upper river basin. Each annual flood caused the river to meander across the alluvial valleys, cutting and depositing material in the classical meander patterns. During the ebb of the flood the river typically deposited a remainder of its sediment load on the valley floor.

The dams impounded the heavy load of sediment the river historically carried down from the upper basin, and significantly reduced the flood flows which carried most of the sediment through the system. The clear water released from the dams entered the channel practically free of sediment and immediately began acquiring a new sediment load. The dams caused the residual coarse sediment in the river to be redistributed with the result that farther downstream, below each dam, the quantity of sediment was sufficient that the river continued the natural process of meanders and aggradation.

Although river maintenance work started near Yuma, Arizona, prior to 1925, Congress did not pass the CRFWLS Act until March 3, 1925. The present authority under which Reclamation operates the Colorado River Front Work and Levee System is the Act of June 28, 1946. This act authorized appropriations for controlling the floods, improving navigation, maintaining the banks of the Colorado River, dredging and straightening the river channel, and conducting studies necessary to fulfill the foregoing objectives.

The physical control and training of the lower Colorado River have generally been accomplished by the construction of the system of levees, river realignment, and river control structures. River control structures include bankline reinforcement, riprap, jetties, and training structures. The dredging activities have been used for channel realignment, development of material for levee construction, sediment control, and environmental enhancement.

Reclamation's Yuma Area Office (YAO) is responsible for maintenance of the Colorado River from the SIB to Davis Dam which is approximately 276 river miles. Each year YAO performs an inspection of the Colorado River and identifies bankline areas, levees , and river structures that require maintenance (Table C-1). For this ongoing maintenance activity on the river and levees, YAO has a need for up to 60,000 cubic yards of riprap and up to 20,000 cubic yards of gravel per year. Normally Reclamation crews perform the

Table C-1. Levee & bank line system for the lower Colorado River by river-miles and division.

	LEVEE	BANK LINE
1. LIMITROPHE DIV. RM.00 TO RM.22.1		
A. Limitrophe Levee	22.10	
B. Limitrophe Bank Line		4.0
2. YUMA DIV. RM.22.1 TO RM.43.2		
A. South Gila Levee	3.7	
B. Upper Yuma Valley Levee Arizona	7.9	

C. California Upper Reservation	11.4	
D. California Lower Reservation	4.2	
E. California Bank Line		6.5
3. LAGUNA DIVISION RM.43.2 TO RM.49.2		
A. Arizona Bank Line		4.73
B. California Bank Line		4.73
4. CIBOLA DIVISION RM.87.3 TO 106.5		
A. Arizona Levee	14.4	
B. Arizona Bank Line		16.25
C. California Levee	14.8	
D. California Bank Line		18
5. PALO VERDE DIVISION RM.106.5 TO RM.133.8		
A. Arizona Bank Line		22
B. California Bank Line		22
C. California Levee	2	
6. PARKER DIVISION RM.133.8 TO 177.9		
A. Arizona Bank Line		12.2
B. California Bank Line		12.95
7. MOHAVE DIVISION RM.233.9 TO 276		
A. Arizona Mohave Levee	25.4	
B. Arizona Bank Line		20.6

C. California Bank Line		13.75
D. Mohave Levee Nevada	7.9	
E. Mohave Bank Line Nevada		9.75
TOTAL *	**113.8 Miles**	**167.46 Miles**

* Totals include sum of miles for both banks of the Colorado River

maintenance by hauling and placing the riprap on the banklines and levees. Reclamation endeavors to locate the quarry sites within economical haul distances from the stockpile sites.

With the exception of bankline work in the Yuma and Limitrophe Divisions, most needed levees and banklines along the lower Colorado River are in place, and future work will not require the construction of new structures. Future work will only include periodic structure repair and stockpile replenishment as required to compensate for material that has been used for routine maintenance requirements and to repair flood damage. The annual amount of material needed may vary. The anticipated annual average need is 80,000 cubic yards of mined material through the year 2005.

Material used for routine maintenance activities and to repair flood damaged structures can be obtained from approximately 45 existing material stockpile sites. These sites are located along the lower river from near Davis Dam to the SIB. Material from any of these stockpiles may be used to repair flood damaged structures. The anticipated 80,000 cubic yards of material needed to annually replenish these stockpiles may be obtained from any of the existing quarries as shown on Figure C-1.

The first dredging on the Colorado River system occurred in the Yuma area in the early 1900s, and during the following 40 years incidental channel improvements were effected to correct local problem areas. Dredging is by definition the excavation of material under water, and the first machines were essentially of the dragline or bucket type.

The Bureau of Reclamation acquired the 16" hydraulic suction dredge "Colorado" in 1949. Work began in the Mohave Valley area to alleviate the flooding problem at Needles and was extended upstream to stabilize the meandering channel alignment. Subsequently, the dredge "Colorado" was moved to the Blythe area in the southern Palo Verde valley where it accomplished the channel realignment known as the Cibola Cut. The "Colorado" was then dismantled and replaced with 12" hydraulic suction dredges which are better sized for the scope and nature of the maintenance dredging and the remaining improvement projects.

The present and foreseeable dredging program is described later in the sections pertinent to specific river divisions.

The Colorado River system has approximately 50 backwaters that would benefit from dredging and other physical renovation. The Back Water Subcommittee of the Lower Colorado River Coordinating Committee is presently prioritizing a list. Reclamation is prepared to provide dredging to those backwaters on a cost-shared basis.

Major Activities Along the Lower Colorado River

For administrative purposes the lower Colorado River has been divided into maintenance divisions which are roughly determined by different physical characteristics, which are shown in Figure 2. The following discussions are indexed according to those divisions.

Mohave Valley Division

The Mohave Valley Division is located between Davis Dam and the Topock Gorge. It is the northernmost of the ten divisions organized under the Colorado River Management Program. It includes the Cities of Laughlin, Nevada, Bullhead City, Arizona, and Needles, California.

Hoover Dam significantly reduced the annual floods that purged the lower Colorado River, however, flows were still large enough for scour and developed sediment to remain significant. Subsequent deposition of the sediment in the headwater delta area of Lake Havasu above Parker Dam, created a problem of severe aggradation in the lower Mohave Valley. At Topock, deterioration of the channel induced more deposition, and by 1943, sandbars extended across the entire channel causing water levels upstream to rise and cause serious flooding at Needles. Although emergency protective works were undertaken, channelizing the river was the only permanent solution. Channel stabilization was initiated in 1949 with the dredging of an improved channel between Needles and Topock and the river was diverted into the new channel on June 25, 1951. To prevent the same aggradation process from repeating itself, the Topock Settling Basin was constructed in order to reduce the flow of sediment into Topock Gorge. This work and associated levee construction eliminated the immediate flood threat to Needles. However, it did not, by itself, provide the river stability between Davis Dam and Topock which was needed to assure that the problem would not recur.

Channel dredging, levee construction, and associated bankline stabilization work which reduced the pickup and transport of sediment, were subsequently accomplished upstream from Needles to a point 10 miles below Davis Dam. The continuous dredging in the Topock Settling Basin was suspended in 1982 due to the gradual reduction of the sediment loads being scoured from the river as the bottom material coarsened and the river approached a steady regime level. Reclamation continues to monitor the sediment transport and river conditions. Dredging has continued in the basin since 1982 on an intermittent basis, and there is a likelihood that maintenance dredging may be required within thenext ten years.

Related work for the improvement of fish and wildlife habitats and recreational features has also been provided. Topock Marsh, which owes its existence to the completion of Parker Dam and the subsequent filling of Lake Havasu in 1938, has been encompassed with a dike to maintain water levels at an elevation of 455 feet above mean sea level (msl). At this level, approximately 4,000 acres of open water are available for fisheries and wildlife management. Inlet and outlet structures were constructed by Reclamation to control water apportioned to the Havasu National Wildlife Refuge. The high flows of 1983 and 1984 flooded parts of the Mohave Valley above Topock Marsh. As a result, a new flood control structure, Topock South Levee, was constructed in order to prevent mainstem floodwater from backing into Topock Marsh. At the same time, revegetation, water control structures, and aquatic habitat development were designed to enhance fish and wildlife conditions. Reclamation also participated in the development of the Needles Marina and Park Moabi near Topock. Popularity of these marinas has increased each year since their construction. Beal Slough, a 30 acre backwater in the latter stages of succession, was dredged by Reclamation in 1979 and 1980 as a part of a cooperative study project aimed at fish and wildlife benefits.

Topock Gorge Division

The Topock Gorge Division extends from the upper end of Topock Gorge to the upper end of Lake Havasu. Minimal maintenance work has been conducted in this Division in the past, due to the natural channel configuration and substrate, which consists of a deep channel bounded by high canyon walls. These are broken to form various small backwater wetlands. This division is entirely within the Havasu National Wildlife Refuge.

Havasu Division

The Havasu Division includes all of Lake Havasu and the river between Parker and Headgate Rock Dams. The effects of the high flows on the river are marked in this division by sediment deposition in the upper end of Lake Havasu. The high flows of 1983 and 1984 deposited 10 million cubic yards of river sediment and extended the existing delta.

The water level in Lake Havasu fluctuates between 440 to 450 feet msl in accordance with the Parker Dam operating criteria, although for practical purposes, the lake elevation has been maintained above 445 feet msl for the last 15 years. During a flood, a potential surcharge to elevation 455 feet msl may develop.

In the Parker Dam to Headgate Rock Dam reach, an area commonly known as the Parker Strip, water levels are determined by discharge from Parker Dam and the backwater effect from Headgate Rock Dam. General channel stabilization activities are minimal due to the channel and bankline substrate. Most stabilization activities in this reach are conducted by entities other than Reclamation to protect local facilities.

This division is the most intensely developed area for recreation along the river. The Parker Strip has been heavily developed for recreation purposes, and in recent years thousands of people have visited Lake Havasu to boat and water ski. Flood releases of 40,000 cfs from Parker Dam in 1983 caused damage to homes and businesses with river frontage in the Parker Strip.

Parker Division

The Parker Division is located between Headgate Rock and Palo Verde diversion dams, and encompasses most of the lands of the Colorado River Indian Tribes' Reservation. It is divided into two sections, Parker I & II, for better administration of the division. Parker I begins at Headgate Rock Dam and ends 2 miles south of Agnes-Wilson Bridge. Parker II starts at River Mile (R.M.) 163.3 and extends to R.M. 133.8, at Palo Verde Diversion Dam.

The channel improvement work in Parker I was completed by 1967. The major aspects of the Parker II channel improvement and stabilization work was completed in early 1995. During the next few years, as the river adjusts to the channel improvements, minor corrective work may be required.

No Name Lake is a backwater area located in the Parker II Division. Approximately 1,200,000 cubic yards of material are to be excavated and placed in the designated areas to restore the Lake to pre-1983 conditions. This is a portion of the mitigation for the Parker II Channel Modification Project.

Other potential marsh and aquatic enhancement in this division includes the rehabilitation of the Deer Island complex, a large lake and marsh in the Parker I area.

Palo Verde Division

The division begins at the Palo Verde Diversion Dam and extends to Taylor Ferry near the Imperial County, California line. Channel stabilization and other improvements are essentially complete in the Palo Verde Division and work primarily consists of routine maintenance and repair to structures. Previous work in this area consisted of earthfill training structures and bank protective riprap designed to prevent random meandering.

C-8 Backwater is located in the Palo Verde Division south of Blythe. It is a mitigation feature which Reclamation maintains. Rehabilitation work was begun in C-8 but was suspended early in 1995 due to lack of funding. It is currently planned to complete C-8 after the work in No Name Lake. Approximately 10 months of work still remains.

Cibola Division

The Cibola Division extends 19 miles from the lower end of the Palo Verde Division to Adobe Ruin, near Walter's Camp. Through much of the Cibola Division, the natural channel was shallow due to sediment deposition. A program to correct channel deficiencies by dredging and constructing levees was initiated in 1964 and completed in 1970. The old river channel was essentially abandoned and became a part of the Palo Verde outfall drain. The river channel in this division is totally stabilized through the use of dredging, bankline riprap, training structures and jetties.

Three Finger Lake is a decadent wetland located on the old river channel and within the Cibola National Wildlife Refuge south of Blythe, California. Approximately 800,000 cubic yards of material have been excavated and placed adjacent to the design lake configuration to restore the lake to its historic conditions. This is a cost-shared effort with FWS.

Imperial Division

The waters behind Imperial Dam, including associated backwater areas constitute the Imperial Division. The division extends through the reach from the lower Cibola Valley, to Imperial Dam. This division receives the sediment generated in the Parker, Palo Verde, and Cibola Divisions. The sediment load arriving in the Imperial Division is either deposited in the overflow areas outside of the main channel or eventually arrives at Imperial Dam to be removed in the desilting works and the forebay of the dam.

In planning for the Parker, Palo Verde, and Cibola Divisions, reducing the sediment flowing into the Imperial Division was a major objective. Reclamation continually collects and processes data on sediment transported by the river. This allows needs to be defined, appropriate corrective measures to be instituted, and the results of control measures to be adequately evaluated.

Most of the diverted sediment is removed by the Desilting Works for the All-American Canal, returned to the river below Imperial Dam and dredged to permanent dry land storage areas near the Laguna Settling Basin, located about 1 mile above Laguna Dam. The desilting works for the Gila Gravity Canal are maintained periodically, by sluicing sediment accumulations down to the Laguna Settling Basin for removal by dredging.

Dredging above Imperial Dam is conducted periodically to maintain diversions for water demand into the All-American Canal on the west end of the dam and the Gila Gravity Main Canal on the east end.

In the main channel above the California sluice gates on the California side of Imperial Dam, about 900,000 cubic yards of material have accumulated over a period of years. This material will eventually be pumped into the river channel below the dam, probably in the next 3 to 5 years. This area is approximately 480 feet by 2,500 feet and is to be cleaned to a depth of about 20 feet. Normally it takes approximately 6 months to a year to clean this area.

The Gila Gravity conveyance channel, just upstream from the dam face, has required periodic work. About 300,000 cubic yards of sediment accumulated here over a period of years and eventually must be pumped by dredge into the river channel below the dam gate for transportation to the Laguna Basin; probably some time in the next 2 to 3 years. This channel is approximately 360 feet wide by 1500 feet long and is dug to an average depth of 15 feet for a total of 300,000 cubic yards of sediment. Working a two-shift schedule it would take 4 months to clean the channel.

Laguna Division

The Laguna Division includes the area between Imperial and Laguna Dams. The Laguna Division receives the sediment returned from the All-American Canal Desilting Works. Because this created problems associated with Mexican diversions at Morelos Dam, in the mid 1960s, Reclamation constructed a settling basin in the Laguna Division where sediment from upstream sources is trapped and pumped with a dredge for disposal onto dry land.

The basin is presently about 50 percent full, and 1 million cubic yards of material will be excavated and disposed of in the adjacent established disposal sites within the next 3-5 years. The work in the Laguna Basin is required periodically as a routine maintenance function.

The time span between dredging depends on the sediment load. Under the present forecasts it appears the work may be scheduled at 5 year intervals. The settling basin is approximately 4,000 feet long by 500 feet wide and is normally excavated to a depth of about 25 feet. The total capacity is approximately 2 millioncubic yards. Working a two-shift schedule it takes approximately 12 months to excavate the basin when it is half full. It is necessary to keep the basin at about half capacity or less, since the trap efficiency (ability to capture sediment) drops off dramatically as it passes the half-way point.

Included within this division is Mittry Lake, a shallow lake east of the Colorado River channel and north of Laguna Dam. The lake has a surface area of approximately 750 acres and is fed by an inlet structure originating at the head works of the Gila Gravity Main Canal.

Yuma Division

The Yuma Division is the reach of the river located between Laguna Dam and Morelos Dam. The river channel extending from Laguna Dam to the upper end of the diversion pool above Morelos Dam was formed by the undiminished natural flow of the river before the dams were constructed. This dominant flow, the flood flows most affecting the channel shape, averaged about 20,000 cfs with maximum flows in the early 1900s exceeding 200,000 cfs, depending upon the time of year and location within the division. While the historic riverbed averages 600 feet in width, only about 120 feet is presently occupied by river flows. The remaining portions of the riverbed, at or near the elevation of ground water, support various growths of vegetation: cattails, cane, arrowweed, saltcedar, mesquite, cottonwood, etc. Above Yuma, vegetation has been partially controlled by intermittent programs of vegetative control - mowing or cultivating.

A 1969 plan for this division called for renovation of the low-flow channel by dredging, reshaping, and lowering the water table under the remainder of the riverbed, and instituting a program of vegetative control. After completing most of the work in the upper 6 of the 20 miles of river channel in the division, the work was suspended pending resolution of environmental concerns. These concerns were met by dredging the area which is currently the open water in Mittry Lake. Prior to that, little open water existed. The lake is now heavily used for fishing.

During the high flows of 1983-1984 the channelization work was destroyed, and the river attacked the levees in several places, which resulted in emergency maintenance. The whole floodplain was essentially inundated, and farm drainage was severely affected.

The 1993 Gila River flood deposited 10 million cubic yards of sediment in the Colorado River channel from the confluence of the Gila River to Morelos Dam and raised the river bottom an average of about 5 feet. This has resulted in complaints from local farmers that the elevated river bottom resulted in groundwater problems in the area.

Due to the flooding of the Gila River in 1993 and high water releases from Painted Rock Dam in 1995, there exists a good probability that dredging will be required. The sediment load in the river channel increased by about 10 million plus cubic yards during the 1993 flood, and with the present Gila flows, that will increase even more. This sediment needs to eventually be removed to increase the capacity of the river channel to prevent overtopping the levees during large floods and to lower the water table in the Yuma valley. Should the funding and permits to do the work be made available, this work will probably be done in the next 10 years. Separate consultation under section 7 of the Endangered Species Act would be conducted for this project. The area to be dredged is located from the confluence of the Colorado River and the Gila River west to Morelos Dam. Should surplus flows on the Colorado River occur in the next 5 to 10 years, these flows may be used to sluice the sediment through the system in lieu of dredging.

Dredging of the river channel between Morelos Dam and the NIB, to relieve the sediment load to Mexico's irrigation system, was completed April 12, 1995. Unless a major flood event occurs or a general dredging project below the Gila confluence is undertaken, it will most likely be necessary to maintain this part of the channel periodically.

Reclamation has an ongoing planning project for the rehabilitation of the river from Laguna Dam to Yuma.

Limitrophe Division

The Limitrophe Division extends from Morelos Dam near Yuma, Arizona, to the SIB near San Luis, Arizona. The river channel in this Division is essentially dry during normal water years, due to the diversion of water for Mexico at Morelos Dam. The United States and Mexico are currently working on plans to relocate the river's channel and increase its flow capacity in this Division to handle conditions such as the flooding during 1983-1985. Severe property damage occurred to Mexico during that time.

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